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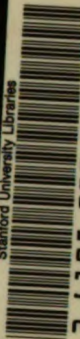
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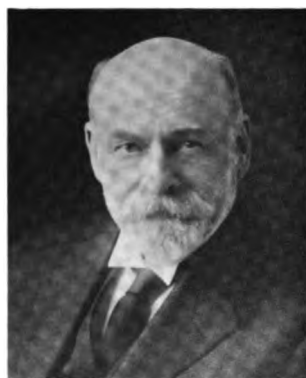
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ENGINEERING

# MINING AND METALLURGY

BULLETIN OF THE  
AMERICAN INSTITUTE OF MINING  
*and* METALLURGICAL ENGINEERS  
WITH WHICH IS CONSOLIDATED THE  
AMERICAN INSTITUTE OF METALS



## SPECIAL FEATURES

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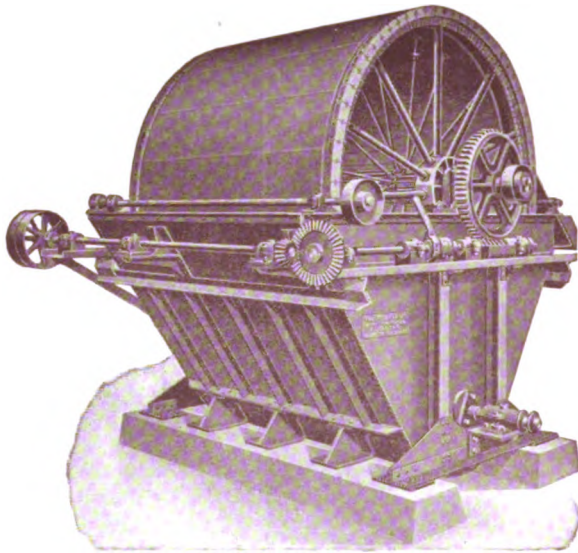
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of

## Mining and Metallurgical Engineers

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### THE APPRECIATION

TO HERBERT HOOVER

The Members and Guests of the American Institute of Mining and Metallurgical Engineers, assembled to commemorate his return home, extend the *welcome* due an eminent American Citizen, a successful Engineer, a Genius of Constructive Administration, a practical Economist, a Statesman of World Vision.

In him they honor an Idealist who was able to vitalize the Altruism of America and save from Hunger and Anarchy vast areas of Europe where millions of men, women and children in a score of languages lift their voices to call him blessed.

He is loved and honored for his gift of leadership and inspiration which called many thousands of volunteers to his aid in the great tasks he undertook and accomplished.

Realizing that no gift of gold or precious stones could convey the deep feeling of appreciation we wish to express, we simply subscribe our names as fellow engineers, co-workers and admiring friends.

**DINNER TO HERBERT HOOVER BY MEMBERS OF THE A. I. M. E.**

Herbert Hoover reached New York from Europe on the "Aquitania" Saturday, September 13.

The committee, appointed by the Board of Directors, had arranged by cable for a reception and subscription dinner to Hoover in appreciation of his unselfish services in the cause of mankind from 1914 to 1919. This dinner was given at the Waldorf-Astoria, New York, on Tuesday, Sept. 16, and only the seating capacity of the available space kept the number of participants down to 1350, which was the third largest dinner ever given in New York, having been exceeded only by that recently given to General Pershing, and by that given to Theodore Roosevelt on the occasion of his election to the Presidency.

The grand ballroom was beautifully decorated with American flags; 2000 three-foot flags being suspended from the ceiling. At the guest table were a great many distinguished Americans, engineers, publicists, and associates of Hoover in his great war work.

President Horace V. Winchell read many telegrams from persons and institutions in this country and abroad, felicitating Hoover on his wonderful work, and after a short speech introduced W. L. Saunders, ex-President of the Institute, as toast master. Mr. Saunders' speech appears in full elsewhere in this issue.

At each table, loose leaf pages were provided for the signatures of members, which were afterward bound in book form, together with an illuminated appreciation to Mr. Hoover, which was presented to him at the close of the dinner. This appreciation is printed on the preceding page. During the evening, there was presented to each guest a large portrait of Mr. Hoover, which was faced with a very brief sketch of his very active career. This sketch is given on p. v.

The Executive Committee in charge of the dinner, which was a most notable gathering, was as follows:

W. L. Saunders, Chairman; Charles F. Rand, Vice-chairman; E. P. Mathewson, Treasurer; A. C. Ludlum, Secretary; Edward B. Sturgis, Chairman Dinner Committee; B. B. Thayer, Chairman Reception Committee; Horace V. Winchell, A. R. Ledoux, J. Parke Channing, E. E. Olcott, Arthur Williams, Mark L. Requa, Edgar Rickard, E. G. Spilsbury.

**Menu**

©

CANTALOUPE, WALDORF

CREAM OF CORN, WITH TOASTIES

CELERY                      OLIVES                      RADISHES

FILET OF SOLE, À LA JOINVILLE

POTATOES PARISIENNE, RISSOLÉES

SQUAB CHICKEN ROASTED

CAULIFLOWER, AU GRATIN

HEARTS OF LETTUCE, RUSSIAN DRESSING

FANCY ICE CREAM

MACAROONS              ASSORTED CAKES              LADY FINGERS

COFFEE

## LIFE OF HERBERT HOOVER

Born West Branch, Iowa, 1874; son of Jesse C. Hoover and Hulda Randal; married, 1899, Lou Henry.

Education: Stanford University, California, as mining engineer.

Consulting and managing engineer; mining, metallurgical and railway operations in United States, Mexico, China, Australia, Russia, Africa, India, 1895-1914.

Took part in defense of Tientsin during Boxer disturbances in 1900.

Chairman of American Committee in London, 1914.

Chairman of Commission for Relief in Belgium.

United States Food Administrator, and

Member of War Trade Council since 1917.

Director General of Allied Relief.

Director General of the American Relief Administration.

Chairman of American Economic Delegation at Paris.

Chairman of Food Section of Supreme Economic Council of Peace Conference, including supervision of transportation and communications of Eastern Europe, and later.

Chairman of Supreme Economic Council.

Publications: Various technical papers including "Principles of Mining" 1905.

Translation jointly with Mrs. Hoover of Agricola's *De Re Metallica*, 1912.

Honors: LL.D.—Harvard, Princeton, Brown, Pennsylvania, Oberlin, Yale, Alabama, Liege, Brussels.

D.C.L.—Oxford.

Commander Legion of Honor.

French Academy Audiffret Prize—1918.

Citizen of Belgium.

Citizen of Finland.

Burgher of Antwerp and many other cities of Belgium.

Honorary member American Institute Mining and Metallurgical Engineers.

Medallist: Mining and Metallurgical Society of America.

National Institute of Social Sciences.

Society of Western Engineers.

Home Address: Stanford University, California.

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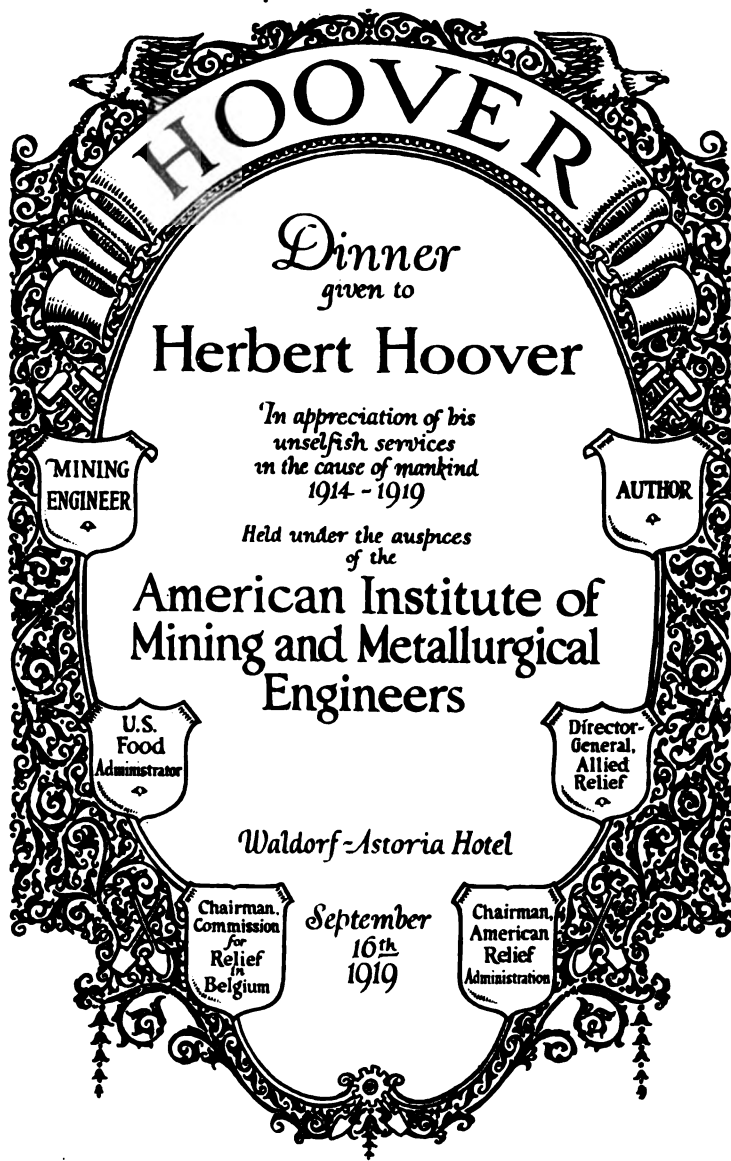
## HAIL HOOVER!

Old Abou Ben Adhem, in his "deep dream of peace"  
Had nothing on Bert Hoover with his war bread recipes;  
For Abou loved his fellow men, according to the scribe,  
While Hoover loved and fed them too, of every race and tribe.

Through war's dread reign he garnered grain in all the seven seas;  
To every famine-stricken land he sent his argosies.  
That he's our leading dough-boy is clearly manifest;  
In head-lines and in bread-lines "his name led all the rest."

Then cheer, cheer for Hoover, the mining engineer,  
Philanthropist and statesman and matchless financier!  
No chronicle of history a worthier feat narrates.  
Thrice welcome, Herbert Hoover, home to United States!

*Anon.*



COVER OF MENU FOR HOOVER DINNER.

## HOOVER: THE TRUE ENGINEER\*

This dinner is a simple tribute paid by the family of engineers to one of its masters. He is indeed a master who, after rising to leadership in his profession, elects to be a servant in the cause of human welfare during a period of great calamity. If there is one reason larger than others for this meeting, it is that we might grasp the hand of our guest and say from our hearts, "God bless you, old man. You have done well. We are proud to know you."

This is no ordinary occasion. Never before have men gathered to pay a just tribute of admiration to one who has done the things that this man has done. His work was not built upon precedent; there was no experience, no guide. It was in fact a creation. In the words of the Prime Minister of England, his work in Belgium was nothing less than a miracle. Yet it is a fact that those who have been in close touch with the situation say that his greatest work has been done since the Armistice was signed.

Truly, this is a period of new things, new changes, new times; a period of agitation which brings to the front new men of true worth. You who are mining engineers know what a good thing the flotation process is, how by violent stirring up of things the metallic values are separated from the gangue and float off at the top. This process has been in action all over the world during the past five years and it has revealed out of the chaos an engineer of the value of pure gold—one

Of manners gentle, of affections mild,  
In wit a man, simplicity a child.

A rugged personality, strong of conviction, modest; thinking never of self; practical, far-seeing, wise, human, brave; with a mind clear in action; a conscience that always functions; one who has saved lives while all others were engaged in destroying them; a rare combination of physical, mental and moral courage; a real American is this Herbert Hoover.

Who is Hoover any way and what is a mining engineer? are questions asked by the man on the street. It is easier to answer the first question than the second. Here at last we have the example of an engineer who typifies the modern definition of engineering which is thus written in large letters on the wall of the Engineer's Library in New York: "Engineering, the art of organizing and directing men, and controlling forces and materials of nature for the benefit of the human race." How well this modest mining engineer has shown that he has the art of "organizing and directing men." Of the many thousands working for him, here and abroad, it is said that not only have they given him loyal support, not only are they glad to work for him, but every man of them would take off his coat and fight for him. How well he has shown his capacity for "controlling forces and materials of nature for the benefit of the human race."

This definition of engineering would have been amazing 40 years ago. The civil engineer was then a surveyor, a mathematician, and a bridge designer; the mechanical engineer an educated mechanic, a designer, and draftsman; the electrical engineer was unknown outside of the school and the laboratory; while the mining engineer was a combination of the

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\*Speech of W. L. Saunders, toastmaster at the Hoover Dinner, Sept. 16, 1919.

geologist and that kind of a chemist who could tell how much phosphorus there was in a steel rail. I make this statement with apologies to Alexander Holley, who in his day was the one and only mining engineer known beyond the fence of the workshop or mine.

But the engineer is at last coming into his own. We see the dawn of a new day; truly there is a new order of things. The great centers of the world are now industrial centers. The prosperity and strength of nations in peace and war rest now upon the factory system, the shops, the railways and steamships, the mines, the smelters, and the public works. And who is responsible for this? Who plans and executes these things? It is the engineer, civil, mining, electrical, mechanical, chemical, and automotive. Such captains of industry are by education and experience best fitted to steer the ship of state. The place for the engineer is not in the dark confines of the hold below, but on the upper deck, yes on the bridge. We are told that practically all the executive heads of the organization for the relief of Belgium were engineers. Who like an engineer is as well trained by education and experience to meet emergencies? He must be prepared for extraordinary conditions. He must foresee these conditions and be ready to act quickly. A mine manager, usually a mining engineer, when told that a pump has broken down in the mine, cannot wait for the common remedies, but must provide in advance for experts and appliances to be on the spot at once and cure the trouble promptly. Is not this the one thing above all others which enabled America to play so important a part in the war? Was it not the spirit of the engineer, his capacity to do things and do them quickly? Surely the war was not won by money, for the enemy was never financially embarrassed. I think we shall all agree that the basic strength of the Allies throughout the war was in the never-dying morale of all the people, including the armies, arraigned against Germany. But what would this strength have availed us but for the resources behind the lines. Modern war resources are mainly coal and iron and the capacity to put these things to practical use on a large scale. The mines would avail little but for the works and the works might avail little but for the men, the engineers who direct them on modern, scientific lines of high efficiency. Mr. Hoover, during the war, gave me the first insight into the Battle of the Marne, when he told me that even the Germans underestimated by 20 per cent. the volume of munitions required in a modern battle. They drew away too fast from adequate supplies.

And so America, through its engineering and industrial strength, helped to save the world from calamity. Now what individual best exemplifies this? Food played an important part in the war. We have heard the cry, that food will win the war. Surely without food no war could be won. It was Mr. Hoover who took care that there should be no food shortage. He did more—he taught thrift to millions of people in all walks of life and in all parts of the world. He preached the gospel of the clean plate. But it is not only in food that our guest stands as an example of achievement, he typifies the engineer, the executive, the man behind the gun. It is easy to see things that lie directly before us, but the best executive is one who builds his fences around the future, who anticipates trouble before it comes. Little has been said of Mr. Hoover's capacity to think straight in advance, but this is really one of his strong-

est characteristics. It was first shown when he took charge of the work of sending Americans over when the Great War broke out. His plans were made and negotiations completed with shippers before the organization was made up and before he had any knowledge of how many persons were to go or where the money was to come from. While forming the Commission for the Relief of Belgium, and before he knew who was to pay the bills, he had ordered millions of dollars worth of food and had chartered ships. When asked why he took such chances he said that it was impossible to believe that the people of the world would not stand behind so wholesome a measure in the interest of humanity, and they did stand behind it nobly and to the end. While Congress was hesitating and amending the Food Act, Hoover was busy organizing every state and territory, even going into the counties of each state, so that when the Act was finally passed the machine had been completed and was ready to function. His abiding faith in public opinion is based upon the belief that the people will always support an unselfish effort to do that which is right.

I have said that there was no precedent for the work done by Mr. Hoover. He has established a precedent for engineers, and for us this is one of his greatest acts. I shall not attempt to tell you all that he has done during the past five years. I am incapable of doing so. The things are so big that one stands aghast in studying them. We have long known him as an able and successful mining engineer. He is an honorary member of the Institute. He was the first choice of the nominating committee for president of the Institute in 1914, but asked to be permitted to forego the honor because he felt that it was his duty to help feed the Belgians.

Herbert Hoover is a graduate of Stanford University. He first served with the United States Geological Survey, then went to West Australia and China, in mining activities. His work in London up to the beginning of the world war was notable in that he departed from the usual share-promotion schemes of the mining market, developing the properties in which he was interested purely on technical lines. He would not countenance any inflation of shares which was not represented in the intrinsic value of the properties. When the war broke out he gave up his management and directorships and steadfastly refused to give any attention to his private affairs during the whole period of the war. He began work the morning after England declared war on Germany, taking charge of the relief of American refugees, advancing funds out of his own pocket, and through his friends, furnishing 45,000 people with money and steamer tickets to get home. In October, 1914, he organized the Commission for the Relief of Belgium. Through this source 9,000,000 people were continually supplied with food, nearly half of them being entirely dependent upon this relief. There were 35,000 Belgians and French engaged with him in this work. He provided 70 steamers in regular service, delivering 4,500,000 metric tons of foodstuffs. The losses in foodstuffs from all causes from the ship to the Belgian warehouse were less than 0.2 per cent. There were 200 American volunteers in this work, serving without salary, most of them paying their own expenses; 80 per cent. of them were university graduates. The total overhead expenses of this Commission were less than 0.5 per cent. He was responsible for the expenditure of \$650,000,000.

Shortly after America entered the war, Mr. Hoover was summoned

to Washington to take charge of the food situation here. The problem was a large one as food demands from Europe were centered upon the United States. His organization in every state and county comprised 8500 men and women, giving their whole time to the Food Administration. In addition to this there were half a million persons registered and ready to be called upon for emergency work. Twelve million families were pledged to support the work. Of the active workers about one-half were volunteers, the others receiving moderate salaries from the Government. It has been estimated that if these volunteers had received the ordinary Government remuneration of \$2,000 per annum the salary bill alone would have been \$9,000,000. Most of these volunteers paid their own expenses. Of the paid employees only thirty-four received remuneration of \$3600 per annum or more. It has been estimated that this administration carried out its functions, 92 per cent. by voluntary effort, 7 per cent. by persuasion and 1 per cent. by legal authority. A conservative estimate of the advertising voluntarily contributed in this work approximates the sum of \$18,000,000. A voluntary conservation campaign among hotels and public eating places resulted in the first six months in saving the equivalent of about  $2\frac{1}{2}$  million bushels of wheat. During  $8\frac{1}{2}$  months, in the year 1918, more than  $16\frac{1}{2}$  million bushels of wheat were saved by conservation at the mills. It is impossible to enumerate all of the activities of the Food Administration. One of the minor activities was the Grain Thrashing Division, organized for the purpose of helping to eliminate wasteful practices. The expenses of this Division amounted to \$55,000, and it has been estimated that the amount of wheat saved was \$44,000,000.

Immediately after the Armistice was signed, Mr. Hoover was directed to proceed to Europe to investigate the part that America could play in the relief of the civilian population. Though he had but four days before sailing he arranged for the purchase and shipment of 250,000 tons of food. It was not until February of the following year that Congress appropriated \$100,000,000 for European relief. At that time several hundred thousand tons of foodstuffs had been actually distributed. Up to a recent date over 3,000,000 tons of foodstuffs, valued at over \$770,000,000, have been distributed.

This is a brief and altogether inadequate statement of a wonderful record of achievement. Certain things stand out with striking prominence. Mr. Hoover was more than a food administrator. He was a general, an organizer in action. He got men to do things. His faith in the moral support of the people was sublime yet practical. He seemed to know the right methods to follow and the psychological moment to act in order to secure the full measure of support.

And so, dear friend, we welcome you home! We rejoice that your five years of labor have produced so wholesome a harvest. We are glad that you are returning to the practice of your profession. We know that we cannot honor you as you have honored us; but in this inadequate tribute of our love may you find some measure of cheer as you journey to the Sierras and your California home. On behalf of this audience, on behalf of all engineers, on behalf of a war-stricken people, who did not pray in vain "give us this day our daily bread," on behalf of all America, let me say to you in the words of John Milton, Servant of God, well done, well done!

## HERBERT HOOVER'S IMPRESSIONS OF SOCIALISM IN EUROPE\*

I have been asked to speak to you on some of the impressions that I have gained during my service in Europe since the Armistice. Two convictions are dominant in my mind. The first comes from contact with stupendous social ferment and revolution in which Europe is attempting to find solution for all its social ills by practical experiments in Socialism. My conviction is that this whole philosophy is bankrupting itself from a startling quarter in the extraordinary lowering of productivity of industrial commodities to a point that, until the recent realization of this bankruptcy, was below the necessity for continued existence of their millions of people.

My second conviction is older but has been greatly hardened, and that is a greater appreciation of the enormous distance that we of America have grown away from Europe in the century and a half of our national existence, in our outlook on life, our relations towards our neighbors, and our social and political ideals. The supreme importance of this Americanism neither permits us to allow the use of this community for experiment in social diseases, nor does it permit us to abandon the moral leadership we have undertaken of restoring order in the world.

During the last ten months I and my colleagues have occupied a unique position in intimate witness of the social currents that have surged back and forward across Europe.

The enemy collapsed not only from military and naval defeat but from total economic exhaustion. In this race to economic chaos the European Allies were not far behind. By this exhaustion, the whole of Europe stood facing a famine, the like of which has not been seen since the Thirty Years War, when a third of the population died of starvation. In the midst of all this was the struggle of a score of new democracies to establish themselves, with friction along every frontier, and with the destruction of governmental institutions, without financial resources to buy supplies, with the miseries of their people offering fertile soil for every economic patent medicine and for all the forces of disorder, Bolshevism and anarchy, and, overhanging all, there could be no hope of restoring normal economic life until the completion of peace. In all this situation, with its desperation, greed, century-old animosities, its idealistic and proper aspirations, there was only one hope. That hope expressed by every city and state, was that the American people, being the one disinterested and uncrippled economic and political force still existing in the world, should again intervene. It was in response to this call that the President, comprehending the real heart of the American people, intervened in Europe a second time and took those steps which resulted in a practical economic organization of Europe, pending the consummation of peace and the arrival of the forthcoming harvest.

This second intervention was not a relief problem in the ordinary acceptance. It was not a problem alone of finding foodstuffs for starving populations of the ravaged regions. It was the problem of finding a large margin of foodstuffs and other supplies for the whole of Europe—Allies, liberated peoples, neutrals and enemies; and in a mass of at least 200

\* Herbert Hoover's speech in full delivered at Hoover Dinner given by the A. I. M. E., Sept. 16, 1919.

millions of these people formerly under enemy domination it was a problem of finding absolute economic rehabilitation. Further than this, it was a problem of warding off Bolshevism on one side and reaction on the other, in order that the new-born democracies could have an opportunity of growth.

Its practical consummation was a problem of the organization of the economic strength of the United States and its coördination with the remaining economic strength of Europe, and, in large areas, the imposition of absolute dictatorship over economic forces. Thus, the shipping of the world required sufficient coördination to transport 30 millions of tons of supplies from all quarters of the globe to Europe. It required the provision of credits to those countries whose total exhaustion abolished all hope of normal payment. It required the insistence upon payment from those who had gold or commodities. It required sufficient coördination of purchase in this vast quantity of supplies that the markets of the world should be affected in the least possible degree. With the dissolution of the organization of the old channels of communication, river craft and railway rolling stock were hoarded by each State; telegraph and postal communications were broken down; every frontier was the scene of more or less military friction, until at one moment there were 25 little wars in progress. Many of these new governments were without experience or even without the existence of departments for the conduct of either the transportation or distribution of supplies.

Thus, it was necessary to secure the erection within their governments of actual departments, to furnish them advisors, to take over the actual operation of thousands of miles of disintegrated railway systems, to open rivers and canals for traffic, to stimulate the production of coal and other primary commodities, to control their distribution through large areas, to find a basis for exchange of surplus commodities from one State to another, to exercise the strongest political pressure to obtain the disgorgement of surpluses into areas of famine, to resort to barter on a national scale where currencies had broken down, to stimulate peoples discouraged and disheartened to efforts in their own salvation, and finally, but not least, to intervene a charitable hand in the saving of their children and the stamping out of contagious diseases, and through all of this economic disorganization to inspire the maintenance of order on one hand and the defeat of reaction on the other. Beyond this again, the necessity of constant friendly intervention in frontier quarrels to prevent the starting of more wars.

These things have not been solved by the service or direction of any one man. They have been accomplished through coördination of the men, of good will in twenty governments of Europe, and throughout by creation of a thread of American personnel, directed from a single center. On our side it has required the coöperation of Congress, the Grain Corporation, the Treasury, the Shipping Board, the Army, and the Navy. A thousand Americans were sent into these communities with but little authority beyond their own assurance and the confidence on all sides that they were disinterested, that their only desire was to solve a great and human emergency for no political and no commercial advantage. It was our desire to do this from the background, without ostentation, to act at all times through established institutions, to build up their strength for the time they must rely upon their own resources. I cannot pay enough tribute to all these thousand Americans, many of them engineers, men

taken from the common life of the United States, thrust into the face of staggering political, economic problems, the solution of which must affect the well-being not of hundreds but of millions. The proof of their performance lay in the fact that Europe has come through the most terrible period of its history with no loss of life from economic causes, with a stronger democracy and a glow in its heart for the United States.

This service of American people has been accomplished at no mean national sacrifice. From the Armistice to this year's harvest there has been furnished over two and a quarter billion dollars' worth of supplies, the majority of which has been given freely upon the undertaking of the assisted governments of repayment at some future date. There has been no demand of special security; no political or economic privileges have been sought. It may be years before we receive any return from these loans, but if that period should never come the American people, by this second intervention in Europe, have saved civilization, and have done so with no thought to the burden or cost to themselves. These matters have been brought to a successful close with the arrival of the harvest and the prospect of peace. What the future has a right to demand from us in further economic support is not yet clear, but it is at least certain that if the world cannot quickly secure the settlement of peace and safeguards for the future through the League the whole of our two great interventions in Europe will have gone for nothing, and the menace of reaction will again return against us upon the winds of chaos.

As the executive head of this Allied effort in economic control, I have thus had an intimate contact with the common people and their officials. I have witnessed their improving physical condition, the constant change of currents of social, political and economic forces, their revolutions, and I have had to deal intimately with the results of all these phenomena. During this period since the Armistice, we have witnessed social and political revolution among one-third of the civilized world, and we see the remainder in great social tribulation. No contemporary can properly judge or balance the relative volume of great currents of social agitation. They are matters of mind and not of matter. Yet practical statesmanship requires that within our abilities a constant accounting should be taken of the tangible results of these forces abroad, if the development of our liberal institutions and progress of orderly government is to be maintained and revolution avoided.

This cataclysm of social change in Europe is the result of the long cumulation of social as well as political wrongs, it is no sudden afterthought of war. These forces were projected into actual realization by the collapse of the war, the breakdown in the political institutions that had preceded it, and the misery that has flowed from it. Our soil is not so fertile as that of Europe to many of these growths, because we have a larger social conscience. We have not the vivid class and economic distinctions of Europe nor have we the depth of misery out of which these matters can crystallize. Nevertheless, in these days of intimate communication, social forces are rapid in their penetration and social diseases are quick in universal infection.

The general revolution of Europe of the last century, starting with the French Revolution, profoundly changed the whole social order of the world, and, while in that revolution the spiritual impulse was the demand for political liberty, there was also a great economic impulse. That economic impulse was primarily the division of the land, and one of the

fruits of that revolution was the better distribution of wealth among the agricultural population. Since that time an enormous expansion of mechanical industrialism has been superimposed upon all agricultural states, with a large increase in urban populations. The economic impulse of the revolution today is the demand for a better division of the wealth from this industrialism, and this time the agitation arises mainly from the urban populations.

These vast masses of humanity in Europe have long been groping for the method of nearer equality of opportunity and better distribution of the results of industrial production. These gropings and these attempts have in recent years been dominated by Marxian Socialism, developed in different degrees of intensity. Broadly, these revolutions have taken two forms: the Bolshevik form, through which there has been over-night communization of all property, and second, the milder form of legislative nationalization of industry. I believe we are now in position to take some stock of and to form some judgment as to the adequacy of these solutions for what I believe every liberal-minded man believes is a necessity—the better division of industrial production.

We require only a superficial survey to see that the outstanding and startling economic phenomenon of Europe today is its demoralized industrial production. Of the 450 million people in Europe, a rough estimate would indicate that they are at least 100 million greater than could be supported on the basis of production, which has never before reached so low an ebb. Prior to the war, this population managed to produce from year to year but a trifling margin of commodities over the necessary consumption and to exchange for supplies from abroad. It is true that in pre-war times Europe managed to maintain armies and navies, together with a numerically small class of non-producers, and to gain slowly in physical improvements and investments abroad, but these luxuries and accumulations were only at the cost of a dangerously low standard of living to a very large number. The productivity of Europe in pre-war times had behind it the intensive stimulus of a high state of economic discipline, the density of populations at all times responded closely to the resulting volume of production. During the war, the intensive organization of economy and consumption, the patriotic stimulus to greater exertion, and the addition of women to productive labor, partly balanced the diversion of man-power to war and munitions. Both the pre-war and the war impulses have now been lost and the productivity of Europe has steadily decreased since the Armistice.

It is true that some of this diminution in production has been contributed to by the other factors, but in the larger degree the cause of this steady decrease of productivity, with its shortage of necessary supplies and its rising cost of living, must be sought in the social ferment, with its continuous imposition of Socialist ideas. In this ferment, the advocates of Socialism or Communism have claimed to alone speak for the downtrodden, to alone bespeak human sympathy, and to alone present remedies, to be the single voice of Liberalism.

We may examine these phenomena a little more closely. In Russia, we have a great country in which the population, with the exception of a small minority, were comparatively well fed, warmly clothed, and warmly housed. They were subject to the worst of political tyranny, were deliberately steeped in ignorance and superstition, yet their productivity was sufficient to enable them to provide these primary comforts and to

export more foodstuffs than the United States. Socialism was brought in over night at the hands of a small minority of intellectual dilettante and criminals, and this tyranny of minority, more terrible even than the old, has now had nearly two years in which to effect the conversion of the wicked competitive system into the Elysium of Communism. Today two-thirds of the railways and three-fourths of the rolling stock that they control are out of operation. The whole population is without any normal comforts of life and plunged into the most grievous famine of centuries. Its people are dying at the rate of hundreds of thousands monthly from starvation and disease. Its capital city has diminished in population from nearly 2,000,000 to less than 600,000. Prices have risen to fantastic levels. The streets of every city and village have run with the blood of executions, nor have these executions been confined to the so-called middle and upper classes for latterly the opposition of the workmen and farmers to this regime has brought them also to the firing squad in appalling numbers.

If we examine the recent proclamations of this group of mixed idealists and murderers, we find a radical change in their economic and social ideas. They have abandoned the socialization of the land, for they find the farmer will not produce for payment in high-flown and altruistic phrases. They have reestablished a differential wage in an attempt to stimulate exertion and ambition of skilled labor. They have established a State Savings Bank, in order to stimulate production through making provision for family and old age. They are offering fabulous salaries for men capable of directing the large agencies of production. In fact, while in the midst of flowery verbal endeavor to maintain that they are still Socialists, they are endeavoring to restore individual ownership of property and of the results of labor. The very High Priest of Socialism is today vainly endeavoring to save his people from their total destruction by summoning back the forces of production. The apologists of this debacle are telling us that it is due to the Allied blockade, and to various other oppositions, but any one with a rudimentary knowledge of Russia knows that they did have within their borders ample supplies of food, coal, oil, wool, flax, cotton, and metals and the factories with which to work them in abundance, and that their sole deficiency is human effort.

We could take another example of Bolshevism in the efforts of Bela Kun and his colleagues in Budapest. The distinction between this situation and Russia is that they were dealing with a population of much higher intelligence, of much higher average education, and it required but three months for the working people of Budapest to realize the fearful abyss into which they had been plunged. It was solely due to the efforts of the trade unions in Budapest that the Bolsheviks were thrown out of Hungary.

These are the extreme points where Socialism has had its opportunity for immediate and wholesale application, according to all of the precepts of its advocates. Elsewhere in Europe Socialism has proceeded through established institutions and we may shortly examine the results here also. During the war large measures were taken on both sides of the front to secure the mobilization of production and distribution to its maximum use in the struggle. There was effective socialization of vast sections of industry. These measures are being continued and extended today in many places by governments anxious to maintain the stability of institutions even at the sacrifice of economic safety, but under the

threat of minorities of revolutionary action. Yet here again the same prime weakness has proved itself. The only partial success of these measures in war was due to the great patriotic impulse of war. Those who conducted these large operations were men whose initiative and capacity had been selected by the competitive system. These war impulses have been lost, and these organizations with constantly decreasing efficiency even in war now face disaster from and with reduced productivity. All these decreases have immediate results in a rising cost of living or the necessity of governments to subsidize commodities—such as bread. There is no better example of this than the coal industry of Europe, and even omitting Russia, this production has fallen from a rate of 600 million tons per annum at the Armistice to a rate of 450 million tons recently. The coal industry is in modern life the very life blood of the State, and it has proved itself the most susceptible among all the industries to these influences, and its production today is at such an ebb as to jeopardize the entire social fabric. I am convinced that the greatest proportion of European leaders of Socialism today to some extent realize this bankruptcy and are today endeavoring to cover a retreat with loud complaints as to the failure from other causes. Nevertheless, the realization itself is a great step and is bringing the turn of the tide and through it Europe is on the road to economic recovery—if she gets peace.

The whole of these various sorts of Socialism are based on one primary conception, and that is that the productivity of the human being can be maintained under the impulse of altruism and that the selection of the particular human for his most productive performance can be made by some superimposed bureaucracy. Their weakness is the disregard of the normal day-to-day primary impulse of the human animal, that is, self interest for himself or for his family and home, with a certain addition of altruism varying with his racial instinct and his degree of intelligence. They fail to take into account, also, that there is but one sufficiently selective agent for human abilities in that infinite specialization of mind and body necessary to maintain the output of the intricate machinery of production, and that is the primary school of competition.

My emphatic conclusion is, therefore, that Socialism as a philosophy of possible human application is bankrupted.

Although Socialism has now proved itself with rivers of blood and suffering to be an economic and spiritual fallacy and to have wrecked itself on the rock of production, I believe it was necessary for the world to have had this demonstration. Great theoretic and emotional ideas have arisen before in the world's history and have, in their bankruptcy, deluged the world with fearful loss of human life. A purely philosophical view might be that these experiences are necessary to humanity, groping for something better. It is not necessary, however, that we of the United States, now that we have witnessed these results, need plunge our own population into these miseries and into a laboratory for experiment in foreign social diseases.

Bankruptcy of the Socialist idea, however, does not relieve us from the necessity of finding a solution to the primary question which underlies all this discontent; that primary question is the better division of the products of industry and the steady development of higher productivity. This bankruptcy of the Socialist idea should, if reaction is to be prevented, return the guardianship of this problem from the radical world

to the liberal world of moderate men, working upon the safe foundations of experience.

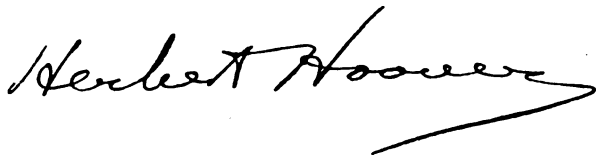
The paramount business of every American today is this business of finding a solution to these issues, but this solution must be found by Americans, in a practical American way, based upon American ideas, on American philosophy of life. A definite American substitute is needed for these disintegrating theories of Europe. It must be founded on our national instincts and upon the normal development of our national institutions. It must be founded, too, upon the fundamental fact that every section of this nation, the farmer, the industrial worker, the professional man, the employer, are all absolutely interdependent upon each other in this task of maximum production and the better distribution of its results. It must be founded upon the maximum exertion of every individual within his physical ability and upon the reduction of waste both nationally and individually. We can well see a vivid confirmation in Europe of the fundamental economic principle that the standard of living and the cost of living is the direct quotient of the amount of commodities produced; that we must secure a maximum production of the industrial machine if we wish to keep our population alive or if we wish to see an increase in the standard of living of our people. From this only can arise the very foundations of the higher activities of life. The application of this proposition must, however, stand several tests. A maximum production can only be obtained under conditions that protect and stimulate the physical and intellectual well being of the producer. We shall never remedy justifiable discontent until we eradicate the misery which the ruthlessness of individualism has imposed upon a minority.

If I were thinking aloud I would say at once that this maximum production cannot be obtained without giving a voice in the administration of production to all sections of the community concerned in the specific problem; that it cannot be obtained by the domination of any one element. I would say that the human race had increased its standards of productivity and therefore of living through the growth of extraordinarily intricate organization of production and distribution based upon stimulation of the individual by the reward it offers. I would also say that it cannot be obtained from the destruction or sudden disturbance of this delicate and intricate organization of production and distribution or extravagance in its products. I would say the road lies along the better division of the more exorbitant profits that arise from these processes and that have accumulated from them. By better division of profits, I do not refer particularly to profit-sharing schemes but to the broad issue of the whole social product. Some are comparatively overpaid and many are comparatively underpaid for the service they render to the community. Our organization in many aspects is not all that we could desire, but it is the best we have been able to evolve over thousands of years, and the destruction of these processes or of the organization which conducts them has been demonstrated to be the sure road to destitution and fearful loss of life.

It is not that we, today, have suddenly awakened to this necessity for better distribution of profits. The social conscience of this country has been manifesting itself continuously concerning this matter for years. We have in the United States today a better division of wealth and a greater equality of opportunity than any other nation in the

world and we have thus a better foundation upon which to build. We have reason for discontent in the fact that our industrial development has outrun our social progress and we have reason to hasten those measures that lead to larger justice in distribution of these profits, larger representation of all elements of the community in the control of these agencies, to further strengthen our measures for the restraint of economic domination by the few and for the liquidation into the hands of the many of the larger industrial accumulations in the hands of the few that our rapid development has made possible.

Again I wish to repeat, the observation of these forces in Europe has reinforced my Americanism during these last ten months of intimate contact with them; it has revealed to me the distance of our departure from the political, social and economic ideals of Europe. There has grown in this United States a higher sense of justice, of neighborly service, of self-sacrifice, and above all a willingness to abide by the will of the majority in every section of this community. This Americanism is the guarantee of the ability of our people to solve this most momentous internal problem confronting our generation. But these very ideals, this very sense of justice and service for our own people give us still further opportunities. Our sister civilization in Europe is today recovering from a great illness. The many new democracies that we have inspired are striving for our ideals. We alone have the economic and moral reserve with which to carry our neighbor back to strength. To do this is also true Americanism.



#### ENGINEER AUTHOR OF THE "MARSEILLAISE"

The history and author of the French national anthem "The Marseillaise" is to be commemorated with a \$200,000 national monument to be erected in Strasbourg.

In 1792 Rouget de l'Isle, then a Captain of Engineers, sang for the first time his "Chant de guerre de l'armée du Rhin."

When on the 29th of April, 1790, the French National Assembly declared war against Franz II, Emperor of Austria, Rouget was stationed at Strasbourg, which then belonged to France. Dietrich, the Burgomaster of Strasbourg, called the leaders of every profession to a conference to decide upon the necessary preparations. This serious conference wound up into a gay social affair and one of the jovial party remarked how nice it would be if the Army of the Department of the Rhine could march to its own war song. Rouget de l'Isle set about the task and composed on the spot a military song which he called "Chant de guerre de l'armée du Rhin," which renamed has become France's inspiring anthem

## HOOVER THE NEAREST APPROACH TO A DICTATOR SINCE NAPOLEON\*

### VASTNESS OF HIS WORK REALIZED AS HE RETURNS

#### THE ONE MAN IN WHOM ALL EUROPE HAS ABSOLUTE FAITH

Hoover has been the nearest approach to a dictator Europe has had since Napoleon. His responsibility and power were tremendous. He fed the whole of Europe east of the Rhine.

"Only through him could the nominal powers of Europe—the Supreme Council—get their voice heard in those regions. He made himself—or was made—in reality supreme economic dictator, and in Europe the economic factor swamps everything else at present."

In these words, the Manchester *Guardian* pays tribute to Herbert C. Hoover, now that he has departed from Europe after finishing his job of feeding and clothing and industrializing the score of nations which would have gone under but for his genius of organization. According to Edgar Rickard, the man who has represented Mr. Hoover here in matters pertaining to the relief organizations, it was this genius of organization which made Hoover the power he was.

"People speak of Hoover as a food expert or food administrator," said Mr. Rickard at his New York office two days ago. "Somehow the impression might be gained that Hoover limited his work to purely food questions. Hoover's job was a greater one than determining whether the nation should eat doughnuts or bran muffins. Hoover is an economist above all, and if such a term were possible I'd say he was an engineering economist.

#### TRAINED TO QUICK DECISIONS

"His wonderful aptitude at making correct decisions in an emergency can be traced to his training as an engineer. It was the knowledge of what that training meant and the appreciation of the need of it that caused him to choose a large number of his men from the ranks of his own profession. The world was at war or, what was equally chaotic, just getting over a war. Things were out of their normal proportions; men were out of the groove of normal thinking; life, industry, international relationships were disorganized. The need of thinking quickly and acting quickly was paramount. To a man who has been accustomed to handle the many intricate problems connected with mining operations, where the clear-headedness of the moment means the difference between success and failure, quick thinking and quick action become second nature. Hoover possesses those qualities to the nth degree.

#### ASSUMES A \$10,000,000 LIABILITY AHEAD OF OFFICIAL SANCTION

"The armistice was signed on the 11th of November. On the 18th of the month Hoover sailed for Europe with instructions to ascertain the part that America should take in the relief of the civic populations. Before he had gone he left an order for the immediate shipment of 250,000 tons of food. The ships carrying this food were sent in two streams, one going to Falmouth, England, to await orders to sail to the northern ports

\* Reprinted from the New York Times, Sept. 14, 1919.

of Europe, the other to Gibraltar for shipment to the Mediterranean ports. This initial order of food was valued at some \$50,000,000. The Government had not yet made its appropriation; that did not come until the following February, but Hoover knew the needs of the starving nations and felt assured that the governments of the world or even commercial credit would be forthcoming. It was the same sort of foresight that characterized his work when he formed the Belgian Relief Commission. There, too, he had committed himself for about \$10,000,000 worth of food before he had been assured of official sanction. He is a genius at cutting the red tape that would bind the activities of a lesser man.

"The job that met Hoover upon arriving in Paris was one without parallel in the history of the world. He had to survey and discover the needs of a continent made up of disrupted nations and newly born nations. It is hard to say which was the more difficult task or what was the difference in the difficulty of handling them. Nevertheless, with headquarters established at Paris, the work was speedily taken up.

### THREE CLASSES OF AIDS

"In mapping out his course of action Hoover called upon three distinct classes of men to help him. First, there were the men who had been associated with him in the Belgian relief. They knew how to apply relief. Second, there were the Food Administration men. These were invaluable by virtue of their knowledge of food resources in our own country. Third, there was the whole expeditionary force from which he could have his pick in choosing the men he wanted for their military standing and ability. These were necessary in countries where only the uniform spelled authority. The combination of forces presented by these three types made a highly efficient machine, at the head of which was a man possessed with a master mind, at coordinating them."

The problems that met the head of the Relief Administration were many and varied. First of all there was the feeding of the populations of some twenty countries. During Hoover's administration of the food resources of the relief administration the following countries were taken care of: Finland, Esthonia, Letvia, Lithuania, Poland, Germany, Holland, Denmark, Belgium, Northern France, Czechoslovakia, German Austria, Hungary, Greater Serbia, Italy, Rumania, Bulgaria, Turkey, Armenia and Russia.

Secondly, there was the rebuilding of industries by ordering special shipments of necessary material to those countries where work was at a standstill for lack of them.

Third, there was the organization of some basis of exchange between neighboring countries, which, through depreciation and rapidly varying value of currency, could not come to any terms of exchange.

Fourth, there was the care and exchange of repatriated prisoners, a job originally in the hands of the Supreme Council, but shifted for lack of movement into the field of Hoover's activities.

Fifth, there was the speeding up of natural production of every kind and the settling of disputes among the greatly disorganized laborers.

Sixth, there was the organization of communication facilities which had been greatly disrupted during the war.

Seventh, there was the care of the undernourished children, a field of activity in which Mr. Hoover was especially interested.

## DECIDED WHO SHOULD RULE SOME TERRITORY

There were a good many other things, such as acting as mediator, instructor, and in one or two cases dictator as to who should or should not rule a bit of disputed territory. To the glory of America be it said that Mr. Hoover never once forgot what the war had been fought for and he minced no words in letting the powers that be know it.

In treating with the question of food, Mr. Hoover studied the problem from the standpoint of future needs as well as from that of present demands. The following extract from a report submitted to him will serve to show the nature of his work.

"The food problem of Galicia is different from that of the Kingdom of Poland (the term 'Kingdom of Poland' excludes those Polish territories which were formerly held by Germany or Austro-Hungary). A large part of Galicia lies in the foothills or in the mountains of the Carpathians, a territory not permitting intensive agriculture and not self-supporting before the war. In times of peace the peasants went over the range into Hungary and Czechoslovakia for the harvest season and brought back their earnings in the form of grain. Even with the war over this was not permitted this year because of the feeling between the Poles and the Czechoslovaks and the Bolshevik situation in Hungary. During the war troops passed and repassed through this region—Russian, Austrian, German, Polish and Ruthenian. As a result of the military requisitions the territory from Lwow (Lemberg) west of the Dunajec River is practically barren of livestock and farm machinery. The destruction of the villages is complete. Outside of the larger towns practically all the buildings are low, log huts with thatched roofs. Almost every hut was burned. The Russians burned all the Roman Catholic churches, and when the Austrians came back they burned all the Greek Catholic churches. The large cities are as badly off. Gorlice and Dukla are as badly destroyed as the towns in Northern France. Przemyśl and Lwow suffered very heavily. The country is now disorganized and ill-fitted for the intensive labor necessary to till fields idle for five years.

"Transportation is peculiarly difficult. The greater portion of the mountain territory is 20 to 30 km. from any railroad and 60 to 150 km. from the single main line of railroad—from Krakow to Lwow. The roads are fairly good, but it is almost impossible to reach some portions of the mountain districts because there are few horses and no motor transportation.

"There is a fair crop in the foothills and the plains of Northern Galicia that will almost suffice for the next Winter, but the mountain districts have little food and the crop will be too small to last over the Winter months. There is no actual starvation, but the people are living on vegetables and green stuffs, and in the more remote spots many are surviving on roots, herbs, and berries. There is some goat and cow milk, but practically no meat except wild boar. There is no fruit, no white flour, and rye for black bread is very scarce."

## POLAND'S SHARE OF RELIEF

This was written during the latter part of July, when the committee was closing up its affairs. Up to that time Poland had received over 300,000 metric tons of food, of which Galicia was given its share. Under

the conditions obtaining there at the time the division of supplies was no small task, but the men working under Hoover saw to it that justice was done by all the communities.

This distribution of food was not without its dangers. In May, 1919, Mr. Hoover ordered 900 tons of flour to be shipped to Novorossisk, to be sold to refugees concentrated in the coastal towns of the Black Sea Province, in Southern Russia, on the northeastern coast of the Black Sea. The instructions given at Constantinople were to sell the flour to any local Government at 11 cents a pound in exchange for such currency as could be turned into dollars at Constantinople. Further instructions were given that if no Government would buy the flour the A. R. A. men were to sell it directly to the refugees and then supervise its distribution. Four hundred tons were sent in the first shipment. The various attempts to sell the flour which was so badly needed are described in what follows:

#### DIFFICULTIES OVERCOME IN STORAGE AND SALE OF SUPPLIES

"Inability to find safe storage for the flour was the first difficulty encountered when we arrived at Novorossisk on the British transport War Pointer. We were warned by both the British and the Russians that a large part of the flour would be stolen. No guards were available except Russians with Bolshevik tendencies. Looting of British munitions and clothes brought in for the Volunteer Army had been a frequent occurrence. As our flour was on top of the cargo, we paid \$1 a ton to the crew of the War Pointer to move the flour between decks, so that the rest of the cargo could be unloaded first, and thus give us time to arrange for the disposition of the flour.

"Attempts to sell the flour to the Black Sea Government at Novorossisk were of no avail because there is absolutely no money in this country except the Don ruble, which has no value whatever outside of Southern Russia, and because flour was being sold on the market of Novorossisk at a price about two-thirds that at which we were authorized to sell, although only a very small amount of grain was being brought over the Caucasus Mountains from the Kouban province.

"At this moment telegraphic authority was received from the A. R. A. headquarters at Paris to dispose of the flour by accepting the best possible Governmental or municipal promise to pay.

"We then visited Ekaterinodar, 70 mi. from Novorossisk by rail, north of the Caucasus Mountains, in the province of the Kouban Cossacks. Ekaterinodar is the headquarters of the Volunteer Army Government and also of General Briggs and a large British military mission. General Briggs informed us that he had numerous requests for food to be sent to the Volunteer Army, both for distribution among the refugees in the Black Sea province and among the inhabitants of such territory as might be freed from the Bolsheviks. He had expected much larger shipments and had not been notified of the arrival of our flour. He advised the Volunteer Army to accept our 400 tons. When we called on General Drajomirof, Chief of Political Affairs for the Denikin Government, he was willing to take the flour on our terms.

"The contract provided that the flour be delivered to the representative of the Volunteer Army at Novorossisk and be checked and receipted by him, the cost to become a liability of any new Government which might be formed by a union of the Volunteer Army with other forces."

### HOOVER'S ACTIVE PART FELT BEHIND EVERY SHIPMENT

The aim in every instance was to get the food where it was most needed. Behind every shipment there was felt the influence and inspiration of Mr. Hoover. The method of his getting shipments of food into the mountain passes of Montenegro is a case in point. Reports had reached him to the effect that the people in that country were starving for lack of transportation facilities to get food to them in a hurry. Up to that time the Montenegrins had used no other form of carrier service than the pack mule. And there were no mules. Mr. Hoover surveyed the territory, and in a short period had strung up wire tramways over the cliffs.

The reorganization of industry was another form of activity taken up under his direction. Desirous in all cases of preventing pauperization by giving the people a chance to earn a livelihood, he made an attempt to reorganize the industries wherever it was possible. The condition of the cotton mills in Poland was an inspiration for this work.

"I do not wish to finish before paying tribute to the industrial energy of these mill owners which led them to maintain their factories in such splendid shape during five years of idleness," reads the report. "It is an impressive sight to see the thousands of looms in perfect order. I never saw a rusted machine. All were covered with grease and oil and protected from the air by great paper sheets. The carding machines, with their millions of tiny steel pricks, were shining like new, and every piece of machinery left intact in the mills is in perfect order, ready for immediate operation. One of the sad sights of the war is the stagnation of this industry, the silent tomb containing these dead machines, and the faith of these men who daily watched their mills, protecting and preserving all that was left of them, is admirable to the highest degree."

Approximately 25,000 bales of raw cotton were sent to Poland, the greater portion of which was shipped to Lodz, which is the great manufacturing center. The employment which this material will give to the inhabitants of the city is expected to do much toward settling the economic and social unrest there.

### MONEY EXCHANGE PROBLEM

The problem of exchange has been a very touchy one among the smaller nations. Very few of them have as yet established a dependable system of currency. At the time Mr. Hoover went to Europe there was continual bickering and disagreement over terms of trade. Much suffering and starvation which could have been prevented was needlessly aggravated. The Czecho-Slovaks and the Austrians, for instance, could not come to terms on any basis. The Czechs needed transportation material which the Austrians could give them in exchange for beet sugar, but the Czechs were afraid of being cheated, and consequently suffered from a surplus on the one hand and the lack of transportation to ship it on the other. It was then that Mr. Hoover stepped in and formulated a system of exchange that was agreeable to both parties. He did the same thing for the Poles and the Serbs and others, for every combination, in fact, where there was a possibility of barter of any sort. At one time he had to decide how many eggs a locomotive was worth. As a result of his work a movement was started of spreading over the greatest possible territory what there was to be spread.

On July 13, 1919, the following agreement was made between the countries mentioned:

"In accordance with recent contracts between Poland on the one hand and Germany, German Austria, and Czechoslovakia on the other hand, interchange of goods such as potatoes and coal shall be resumed on and after July 30 from these points of transit: Hohensakza, Bromberg, Ercz, Bentschen, Lissa, Adelnau, Kempen." The agreement goes on to give the terms of transit, most of which are an assurance on the part of the German Government that they will play the game straight.

#### BARTER AND EXCHANGE ARRANGEMENTS SECURED 8000 TONS OF WHEAT FOR ARMENIA

A system of barter and exchange was also arranged between Russia and Armenia. It is interesting to note that in speaking about that Mr. Hoover is gratified at the fact that the Armenians can thus get the wheat at one-half the price they would otherwise have to pay if they had to buy it from the American Relief.

"The plan of sending a miscellaneous cargo of hardware, clothing, and other manufactured goods to Novorossisk in the Kouban to barter for wheat for shipment to Armenia has resulted in obtaining 8000 tons of wheat for the Armenians at about half of what the wheat would have cost them if it had been shipped directly from the United States."

Ever since the signing of the armistice the problem of the repatriation of the nationals of the different countries has been a difficult one. Poland alone had some 1,050,000 men scattered over the face of Europe; Russia had an equally large number; Serbia, Hungary, and Austria had them in varying numbers. The work of repatriation had been carried on in the best possible manner by the countries concerned, but there was a lack of coördination and coöperation in the work which tended to demoralize the effort. The results obtained were not in satisfactory proportion to the energy expended. Things were coming to a rather hopeless point when again the man of action, Hoover, stepped into the breach and by special request submitted a plan of coördination of action to the Supreme Council. The letter he wrote them on July 26, 1919, follows, in part:

#### HOOVER'S PLAN FOR PRISONERS

"It appears that there are some 200,000 German, Austrian, and Hungarian prisoners in Siberia and that these prisoners are suffering greatly and are a constant menace to the Siberian Government. There are also certain Polish prisoners and civilians now scattered all over the world who will require more systematic assistance at repatriation, but there is an entire deficiency of funds with which to pay the incidental expenses. There are probably also other odd lots of expatriates of various nationalities as the result of the war who need systematic repatriation. It would appear to me that this problem requires definite organization, and I should like to submit the following plan in the matter for action by the Council:

"First, that a commission comprising a British, French, American and Italian military officer should be set up and undertake the management of this repatriation. That this commission should communicate their appointment to the Austrian, Hungarian, Polish and other Governments, and that they should offer to undertake the repatriation, provided funds are placed to their credit in advance by each of the Governments concerned.

"It would appear to me that if such a body is set up under capable officers they would be able to work out a solution in this manner and to secure from the allied Governments the necessary shipping and other services which would be necessary. They could invite a delegate of each of the governments concerned to sit with them in respect to matters which concerned such a government and they could engage the necessary staff to carry on the work. They would probably need to appeal to various allied Governments and to charitable societies for some assistance in respect to prisoners originating from quarters unable to supply these funds; but, in any event, they would create a center around which all effort of this kind could be directed. \* \* \*

This same organizing genius was again called to the fore when the coal production in the mining regions, instead of gaining an impetus with the closing of the war, fell to a rate of production greatly below normal. Through the efforts of Col. A. C. Goodyear, one of Hoover's righthand men, an agreement was reached between the miners of Ostrau-Karwin coal basin and the mine-owners. A member of the American relief acted as mediator and both the miners and the owners were assured of open hearings and fair play. One of the clauses provides that in order to obtain the agreed "minimum wage" the miners must produce 80 per cent. of the normal production, a definite reasonable rate having been fixed as the normal. The miners have now come to an appreciation of the fact that it is to their advantage to increase the rate of production, every increase meaning a corresponding proportional increase in the wages earned. The members sitting on this wage commission consist of one mining engineer representing the Government, one operating engineer representing the owners, two men in the confidence of the workmen, and a representative of the American Mission who acts as a general adviser. Thus far the results have been very satisfactory.

#### HOOVER'S FIELD TELEGRAPH

When Mr. Hoover went over to Paris in November he found that he could not get into telegraphic communication with his associates owing to the fact that the telegraph systems which had been torn down during the war had never been replaced. Instead of worrying about how he could get the Governments or the nominal Governments to repair these lines, he went about having a special telegraph system constructed for the use of the A. R. A. He called the army and the navy men into the field and before very long telegraphic connections were obtained between the principal points of action. A circuit was established between Trieste, Spalatto, and Ragusa. This was followed by the building of a telephonic and telegraphic circuit between Trieste and Vienna, Trieste and Fiume, Vienna and Coblenz, and Coblenz and Paris. Connections were also made between Austria and Croatia, to Belgrade, to Bucharest; from Vienna to Hamburg, from Vienna to Prague, from Hamburg to Coblenz, and from Vienna to Warsaw. Through coöperation with the navy, direct service was maintained between London and Paris. The policy adopted in establishing this system was the one of borrowing circuits from the local Governments, securing the proper authority for connecting them across the borders where they had been interrupted, and then operating them with American men.

In addition to handling the telegraphic traffic of the A. R. A. and of the many other American organizations, the district superintendents,

acting under instructions from Mr. Hoover, exerted every effort toward influencing the local Governments to re-establish public telegraphic and telephonic communications with one another. Partly as a result of these negotiations with the local Governments, public telegraphic communications have been established in several of the countries. Public circuits are now in operation from Vienna to Berlin; from Prague, Czechoslovakia, to Berne, Switzerland; to Berlin, Vienna, Dresden. Public connections have also been established from Berlin to Vienna, Prague, Sweden, Norway, Denmark, and Switzerland, and attempts are being made to establish circuits between Frankfort, Germany, and Milan, Italy. Every effort is being made to have the public lines put up before the A. R. A. lines are disconnected.

The branch of relief work dearest to Mr. Hoover's heart was the special relief work for children. Wherever possible he tried to organize special committees and special relief units to insure the children an extra meal a day. His attitude in this work can best be portrayed by quoting from a man who was closely associated with him in this branch of the work, Lieut. John M. Oskison:

#### FEEDING THE CHILDREN

"Paris," he says, "was a fairly cynical atmosphere out of which to launch the idea of feeding an extra meal a day to several million kids. Ever so many heads of the wise and great were lifted into the rarefied air which only the winds of world politics blow—and others were so busy tracing the devious trails of old-fashioned diplomacy that they couldn't 'get' the child-feeding idea."

"As I wandered about over Central Europe and met the military, diplomatic and economic scouts of other nations, I caught from them the reflection of Paris. In polite terms, they wanted to know what all this relief effort really meant. I could explain fairly well the general program by saying that America had commissioned Hoover to help save Central Europe from universal anarchy by selling food on credit and trying to aid in starting these young and tottering nations toward economic reconstruction."

"ANYBODY COULD SEE THAT A STARVING KID OUGHT TO BE FED"

"But that child-feeding program. The only thing I could think of in the way of practical argument was that if we didn't help to save these millions of kids from growing into weakling adults, we'd stand small chance of collecting what is owing to us and of developing profitable trade twenty years from now.

"If Hoover hadn't been incurably shy and so stubbornly sound as an economist he might have worked up a lot of economic arguments we could have used—specious arguments, to be sure. But he didn't argue; all I ever got out of him was a sort of indignant statement that the Allies didn't fight the war to punish women and children, and anybody could see that a starving kid ought to be fed."

Before he left for America, Hoover went on a ten-day trip through Central Europe to see what his organization had actually done in translating his ideas into increased rations for child and man. According to Lieutenant Oskison, the ten days were one of suffering for the man. The lack of restraint of language used by the people of Central Europe in expression of their gratitude to him was more than he could stand. The incident at Prague, told by Lieutenant Oskison, was typical.

"At Prague, when the official gratitude of Czechoslovakia was being expressed by President Masaryk and members of his Government, there came a sudden break. Some one faltered—a tear got into his eye or a sob into his throat, some emotional chord was vibrated and the whole show was off! They found at Prague that Hoover was suffering under fireworks; they stopped shooting them off, took him around to see the kids, to eat at the kitchens where the extra meal a day for thousands of youngsters was being cooked and served, and allowed him to inspect things after his own fashion.

"His utter failure to react to the roll of verbal thunder where his organizing genius, his sound understanding of political economy, and his great sympathies had worked miracles was perfectly in keeping with the man and his character.

"Only it was hard for Central Europe to understand."

There was, however, nothing shy about this man when he was doing the thing that he thought the right thing. A case in point was his declaration to the Supreme Council at Paris that, unless the Rumanians

#### TOTAL RELIEF DELIVERIES UNDER HOOVER'S DIRECTION FROM DEC. 1, 1918, TO JUNE 30, 1919

|                      | Metric Tons |                           | Metric Tons |
|----------------------|-------------|---------------------------|-------------|
| Finland.....         | 123,338     | German Austria.....       | 371,101     |
| Estonia.....         | 14,065      | Hungary.....              | 633         |
| Letvia.....          | 4,716       | Greater Serbia.....       | 89,442      |
| Lithuania.....       | 2,137       | Italy.....                | 15,034      |
| Poland.....          | 312,565     | Rumania.....              | 216,666     |
| Germany.....         | 778,924     | Bulgaria.....             | 22,831      |
| Holland.....         | 24,552      | Turkey.....               | 14,458      |
| Denmark.....         | 19,942      | Armenia.....              | 31,060      |
| Belgium.....         | 748,429     | Russia.....               | 15,077      |
| Northern France..... | 88,338      | Russian prisoners in Ger- |             |
| Czechoslovakia.....  | 323,803     | many.....                 | 2,685       |
|                      |             | Total.....                | 3,219,796   |

#### QUANTITIES OF ARTICLES SENT TO THE 21 COUNTRIES

|                     | Metric Tons |                      | Metric Tons |
|---------------------|-------------|----------------------|-------------|
| Breadstuffs.....    | 2,123,874   | Cocoa and sugar..... | 62,146      |
| Beans and peas..... | 81,564      | Cloth.....           | 30,063      |
| Rice.....           | 111,847     | Miscellaneous.....   | 450,642     |
| Meats and fats..... | 288,300     |                      |             |
| Milk.....           | 71,360      | Total.....           | 3,219,796   |

Value of the 3,219,796 tons, \$770,795,000

were ordered out of Hungary and a Hapsburg removed from the power he had surreptitiously been allowed to gain, he would cease making shipments to Hungary. Fearful of his message not getting the publicity it deserved, he released it to the press, saying in part:

"We made an agreement last November changing the rules of the game and under the new rules we must not rob the robber (meaning Rumania's action in Hungary), but that is what is being done." The Supreme Council immediately informed the Archduke Joseph of Hoover's decision and two days after the receipt of the note he stepped down and shipments of food were once more resumed.

## PROPOSED NATIONAL DEPARTMENT OF PUBLIC WORKS

DISCUSSED BY PAST-PRESIDENT MOORE

At the meeting of the San Francisco Section on July 22, 1919, Past-president Moore was the guest of honor and made an address regarding the proposed National Department of Public Works. Mr. Moore introduced his subject by discussing the relation of the engineer to his organizations and to the public. The doctor serves the public by treating the needy free of charge; the lawyer, as an officer of the court is a public servant; the engineer acts as arbitrator between the payer and the payee. A penalty of the large consolidations that have absorbed so many engineers is that the engineer often becomes the mere servant of the organization and loses his independence. Because the engineer is constantly working himself out of a job and changing his residence, his influence in public life is small. To increase this influence, engineers should work as a unit. Engineering organizations are in the start usually purely technical, but with growth in members they find it necessary to widen their activities. Recently several societies, formed with the object of giving the engineer more influence and better pay, have attracted a number of the younger engineers. It is necessary for the older societies to recognize a duty heretofore neglected.

The four national societies are now trying to increase their influence in non-technical affairs. For this purpose, in 1917 (through the influence of Dr. Hollis, then president of the American Society of Mechanical Engineers) each of the four national societies and the United Engineering Society selected five members and formed Engineering Council. An employment bureau was established which now has records of 13,000 engineers and has sent two or three thousand names to Washington during the war. Among the agencies of Engineering Council is the National Service Commission of which the chief object is to watch proposed legislation, transmit information to engineers, and also to initiate legislation. The most important legislation affecting engineers is the bill now before Congress for forming a National Department of Public Works; copies may be obtained by addressing the National Service Commission, McLachan Building, Washington, D. C. This proposed department is to take over the engineering activities now handled by thirteen bureaus in Washington. Mr. Moore described these bureaus in detail, their duplication of work and the resultant waste. At a recent meeting in Chicago the formation of this department was discussed by representatives of 75 societies with 100,000 members; all were enthusiastic. Mr. Moore is authorized to state that Secretary Lane is in favor of establishing this National Department of Public Works, believing that it will work toward efficiency and economy. Funds are needed for propaganda. A liberal engineer has underwritten \$25,000 for the present year, and it is thought that \$50,000 annually will be needed for the next three years. It is hoped to raise this in part from the members of the national societies and in part from the local societies. The amount for each member should be from \$1 to \$10 yearly. In this movement, as in many others, engineers should arrange for joint action. Expected opposition from army engineers is to be guarded against by providing for the present officers for two years and for the instruction of the young graduate engineers of West Point.

In the discussion that followed Mr. Moore's talk, other members gave instances of governmental waste and inefficiency. For example: the Bureau of Standards is apparently encroaching on the work undertaken by the Bureau of Mines in its investigation of alloys. Three sets of investigators were studying the quicksilver deposits of California at the same time. Three commissions were in Europe studying the mineral resources of the war area. Similar investigations are now being made, covering the earth from China to Peru.

A resolution favoring the establishment of a National Department of Public Works was adopted and signed by those present at the meeting.

W. H. SHOCKLEY, Sec'y, San Francisco Section.

### CANADIAN MINING INSTITUTE MEETING

A regular general meeting of the Canadian Mining Institute will be held in Vancouver, B. C., on Nov. 26 to 28, 1919. The Council of the Canadian Institute extends to the members of the American Institute of Mining and Metallurgical Engineers a cordial invitation to attend this meeting.

### A LETTER TO THE PRESIDENT

Aug. 22, 1919.

THE PRESIDENT,  
THE WHITE HOUSE,  
WASHINGTON, D. C.

Sir:

The Committee on National Terminal Affairs of the Society of Terminal Engineers, being aware of a vacancy on the Interstate Commerce Commission, wishes to express to the President that it is the earnest desire of the Society of Terminal Engineers that in filling this or other positions on the Interstate Commerce Commission, he will give serious thought to the selection of men who, in addition to their other qualifications, have had the training and experience of an engineer familiar with transportation problems.

The Society urges that the engineering profession, which has contributed so largely to the creation and usefulness of all the transportation systems of this country, be represented in the membership of the Interstate Commerce Commission, believing that the training and attitude of mind of the engineer which have added so greatly to our national prosperity in the past will be of a similar usefulness to the nation in solving the problems which are to come before the Commission in the future.

Very respectfully,  
(s/d) FRANCIS LEE STUART,  
*President, Society of Terminal Engineers.*

## CLASSIFICATION AND COMPENSATION OF ENGINEERS

The following paragraphs are taken from a letter written to the Secretary of Engineering Council by the Chairman of the Council's Committee on Classification and Compensation of Engineers.

From time to time within the last few weeks, you have forwarded to me various letters addressed to you concerning the proposed "Classification of the Civil Service of Canada" as recommended by Arthur Young & Co. of Chicago, Toronto and New York. The copy of this classification, which was also received, indicates that its preparation was authorized by the Canadian Parliament and that the work was done under the direction of the Civil Service Commission.

These letters offer objections to the classification, particularly on the ground that the compensations proposed for higher grades of service are inadequate. In view of the investigation now being made on behalf of Engineering Council as to the classification and compensation of engineers in Federal, State, Municipal, and Railroad service, this report is of more than usual interest, and especially so since Council's Committee is informed that Arthur Young & Co. are performing a similar service for the Congressional Committee on Reclassification and compensation of Government employees, including engineers.

Engineering Council's Committee on Classification and Compensation for the State and Municipal services has tentatively proposed that all positions in these services be limited to 13 in number, of which 7 are distinctly professional, while the remaining 6 are in a class directly leading to professional work, but not necessarily of a professional character. The Canadian report appears to cover every position in the civil service. It is arranged alphabetically and, in the absence of grouping, a complete analysis of the engineering service involves a task of magnitude greater than I have found time for. I have attempted, however, to make such examination as time permitted and am impressed with a belief that the objections raised are well found. No attempt seems to have been made to standardize titles. Consequently there are in the engineering service at least 157 independent titles as compared with the 13 titles proposed by our Committee. It is recognized that qualification of a general title to show the nature of the service rendered is quite proper, but in the judgment of the writer there is no reason for treating similar positions as entirely unrelated and as warranting entirely independent specifications.

The report states that the compensations proposed are intended for "normal times" and that pending restoration of such times, the rates recommended should be "supplemented by a bonus," but no information appears as to the magnitude of the bonus. From my study of the report it would appear that the groups and ranges of compensation, tabulated as far as practicable under the classification tentatively proposed by Engineering Council's Committee are about as shown in the accompanying table.

In general, promotion through most of the grades is by increments of about \$120, the minimum and maximum rates of each being respectively higher and lower than the rates fixed for the grades below and above, this resulting in a comparatively small salary range for each position and in this respect corresponding with what seems to have been the general practice heretofore. This treatment is one that it would seem desirable to modify to the end that the relative ability and experience of men performing similar work may be given adequate recognition. Exceptions are noted in the case of Topographical Engineer, where a salary range of from \$2160 to \$3120 is proposed, and in the case of promotion from Junior Electrical Engineer at a maximum salary of \$1980 to Electrical Engineer with a minimum salary of \$2640, each of the two latter grades having an extreme salary range of only \$360. In the case of Chief Draftsman, Structural Engineer, and Chief Topographical Engineer maximum salaries are proposed of \$3000, \$3240, and \$3840, with no provision for promotion to other engineering grades, although for each position the qualifications required are such as to indicate ability to progress to high positions in the service. The table also shows that only six engineering positions are open to compensation at a rate of more than \$6000 per annum.

It would seem to the writer that this report is open to serious criticism on the ground that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades is inadequate for the service rendered.

*Tabulation of Titles and Salaries for Engineers in Canadian Civil Service  
Report under Classification Proposed by Committee of  
Engineering Council*

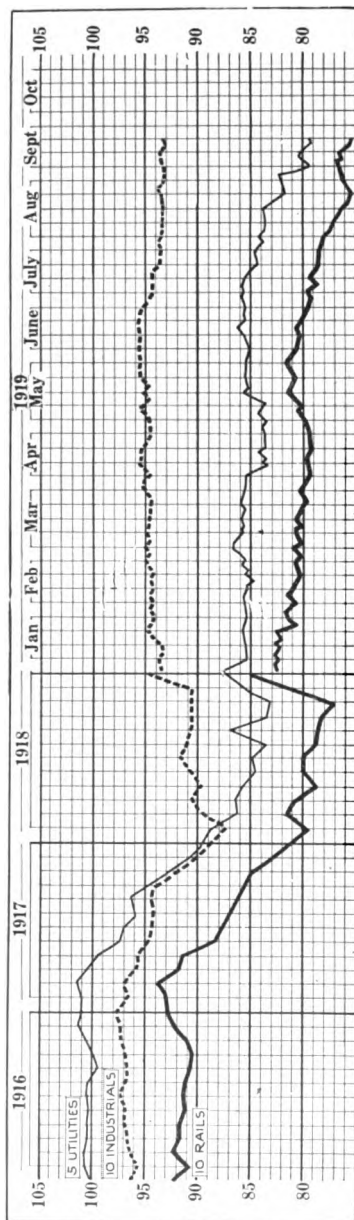
| Tentative Classification of Positions in State and Municipal Service Proposed by Engineering Council's Committee on State and Municipal Service | No. of Titles provided in proposed Canadian Classification | Salary Range Proposed for Canadian Service |                                  |         |         | Qualifications Proposed for Canadian Service<br>Number Years Experience |   |
|---|--|--|----------------------------------|---------|---------|---|---|
|   |  | Usual                                      |                                  | Extreme |         |   |   |
|   |  | Min.                                       | Max.                             | Min.    | Max.    |   |   |
| Consulting Engineer.....  | 1  | \$6,000                                    |                                  |         |         | Professional Engr. 12 (7 in charge).                                    |   |
| Chief Engineer (major work).....  | 5  | 6,000                                      |                                  | \$4,800 |         | Professional Engr. 7-12 (3 to 7 in charge).                             |   |
| Chief Engineer (minor work).....  | 7  | 3,900                                      | \$4,800                          | 3,800   | \$6,000 | Professional Engr. 7-12 (3 to 7 in charge).                             |   |
| Chief Engineer—Deputy.....  | 8  | 3,900                                      | 4,800                            | 3,800   | 5,700   | Professional Engr. 7-12 (3 to 7 in charge).                             |   |
| Engineer.....   | 37   | 3,300                                      | 4,020                            | 3,000   | 4,500   | Professional Engr. 5-10 (2 to 5 in charge).                             |   |
| Senior Assistant Engineer.....  | 40   | 2,640                                      | 3,000                            | 2,400   | 3,480   | Professional Engr. 3 (2 to 3 in charge).                                |   |
| Assistant Engineer.....   | 23   | 2,100                                      | 2,580                            | 2,040   | 3,120   | Professional Engr. 3.   |   |
| Junior Assistant.....   | 15   | 1,680                                      | 2,040                            | 1,680   | 2,160   | Professional Engr. 2.   |   |
| Senior Draftsman.....   |  |  | Included in Professional Service |         |         |   |   |
| Draftsman.....  | 8  | 1,260                                      | 1,560                            |         |         |   | 3 |
| Junior Draftsman.....   | 4  | 900  | 1,200                            |         |         |   | 2 |
| Chief Instrumentman.....  |  |  | Included in Professional Service |         |         |   |   |
| Instrumentman.....  | 5  | 1,260                                      | 1,560                            |         |         |   | 3 |
| Rodman.....   | 4  | 900  | 1,200                            |         |         |   | 2 |

### FORTHCOMING MEETINGS OF SOCIETIES

| Organisation   | Place                | Date        |
|--|----------------------|-------------|
|  |                      | 1919        |
| Illuminating Engineers' Society.....                       | Chicago, Ill.        | Oct. 20-23. |
| American Mining Congress.....                              | St. Louis, Mo.       | Nov. 17-21. |
| Canadian Mining Institute.....                             | Vancouver,<br>B. C.  | Nov. 26-28. |
| American Institute of Chemical Engineers.....              | Savannah, Ga.        | Dec. 3-6.   |
| American Ry. Bridge and Building Association.....          | Cleveland, O.        | Oct. 21-23. |
| American Society of Mechanical Engineers.....              | New York,<br>N. Y.   | Dec. 2-5.   |
| Geological Society of America.....                         | Boston, Mass.        | Dec. 29-31. |
|  |                      | 1920        |
| American Society of Heating and Ventilating Engineers..... | New York,<br>N. Y.   | Jan.        |
| Mining and Metallurgical Society of America.....           | New York,<br>N. Y.   | Jan. 13.    |
| American Institute of Min. and Met. Engrs.....             | New York,<br>N. Y.   | Feb. 16-19. |
| American Ceramic Society.....                              | Philadelphia,<br>Pa. | Feb. 23-26. |

## TREND OF BOND AND STOCK MARKETS

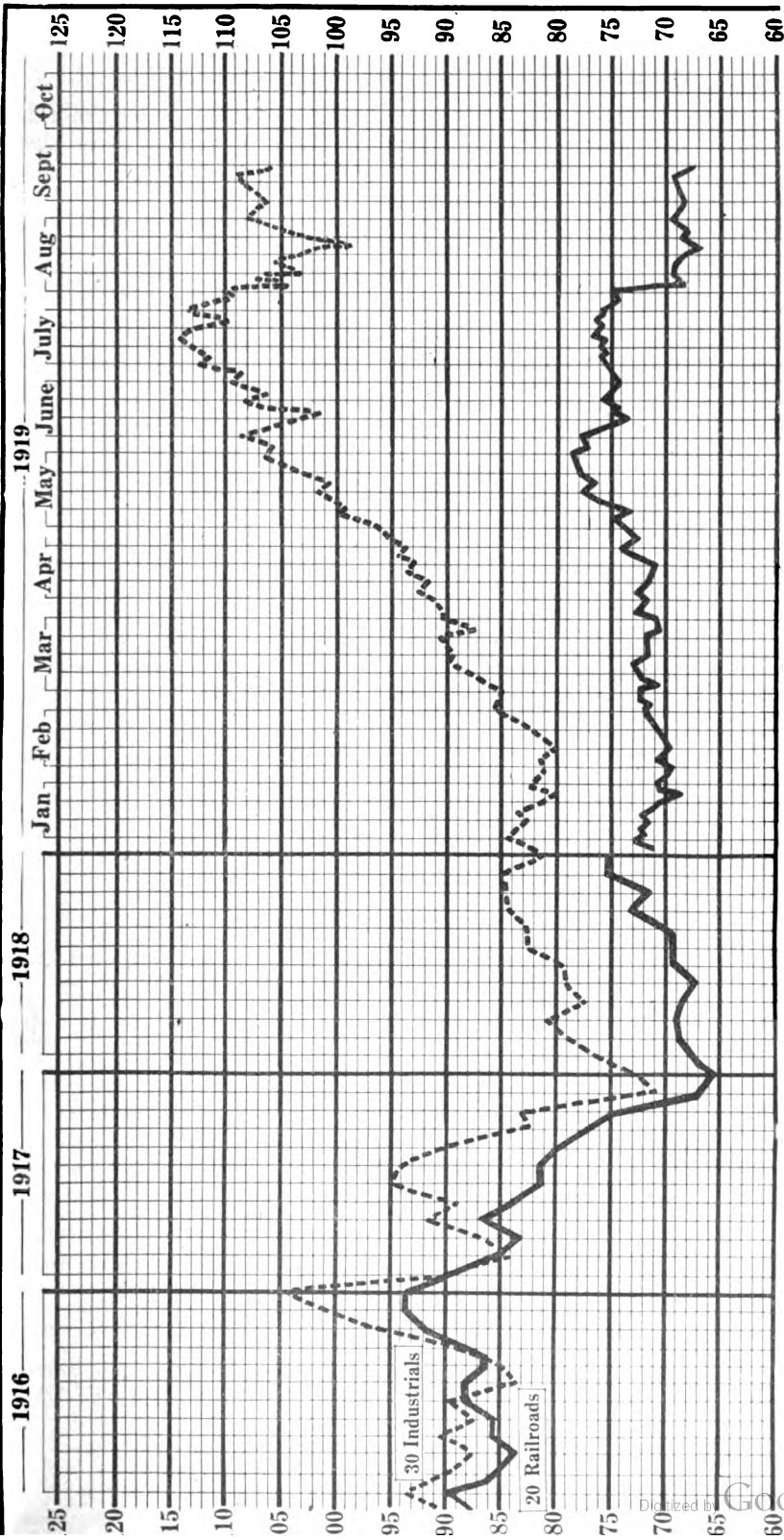
For the benefit of those of our members who are considerable holders of securities, but owing to their isolated situations are not in close touch with the metropolitan market and current quotations, we are publishing



PRICE TREND OF NEW YORK BOND MARKET

This graph shows the average prices of ten railroad, ten industrial and five public utility bonds on the first business day of each month from January, 1916, to December, 1918, and the weekly fluctuations since January 1, 1919.

two very interesting graphs, showing the course of the bond and stock markets in New York over a long period. These graphs are furnished through the courtesy of the financial department of the New York Tribune.



PRICE TREND ON NEW YORK STOCK MARKET

This graph shows the average prices of twenty railroad stocks in one line and thirty industrial stocks in the other on the first business day of each month from January, 1916, to December, 1918, and the weekly fluctuations since January 1, 1919.

## MEXICO IN THE METROPOLITAN NEWS

This brief resume of the events transpiring in Mexico, culled from the daily New York newspapers since the last *Bulletin* went to press, does not show any degree of improvement in the situation.

## MEXICAN OPINION CALLS UPON PRESIDENT CARRANZA TO CHANGE HIS POLICY TOWARD THE UNITED STATES

Advices from Mexico City received in Washington; says the New York *Times*, show that various groups there are demanding a change in Carranza's Government and policy toward the United States.

The Federation of Labor Unions at Mexico City has issued a manifesto asking President Carranza to form a representative Cabinet and immediately adjust the difficulties with the United States.

A circular of the Liberal Constitution Party has been published, calling on adherents throughout Mexico to work for a good understanding between the United States and Mexico.

The Mexican *Herald* editorially says the Mexican Government is showing a disposition to change its policy, and urges the Government to listen to public opinion, which is not in favor of war.

According to *El Universal*, opinion in Mexico demands a complete change in the Mexican Cabinet. "Undoubtedly the key to our present difficulties," this paper is quoted as saying, "lies in Article XXVII. of the Constitution, especially as it pertains to petroleum. This must be faced squarely and patriotically."

The paper *Excelsior* publishes an article entitled "The Nation Has the Appearance of an Enormous Corpse," saying that among the obstacles to better international relations are the articles of the Constitution of Queretaro "so inimical to foreign capital." It expresses the wish that this cause of international friction be eliminated, and says: "We have fought these precepts ever since the Constitution was promulgated, since we regard them not only as unfavorable to our domestic affairs, but as prone to create international complications. The pseudo-socialistic attempts of the Constitutional Convention of 1917 could not fail to bear this bitter fruit."

## CARRANZA LETS DOWN BARS ON DAMAGE CLAIMS

Important concessions have been made by President Carranza in issuing a decree amending the reclamation law. Briefly, they are, according to the New York *Tribune*:

Claims for damages may be presented, not only for losses during the recent two revolutions ending with the installation of the present government, May 1, 1917, but for those sustained since then in various regions where revolts are still smouldering.

Damages by rebels or outlaws to person or property subject to reclamation, when such damage is found to be the result of negligence on the part of constituted authority.

A commission on indemnification will admit any means of proof "humanly reasonable." The claims commission can consider all cases, but the President has the right to arrange conventions with any foreign power for a mixed commission to handle claims of citizens of that power. Claims by railroad companies and other public utilities taken over by the government may be arranged either by the federal claims commission or by agreement between the companies and the Secretary of the Treasury. The claims resulting from death or injury will be paid immediately upon approval by the President.

This pacific attitude was followed in the next days' dispatches by Carranza defying the United States and recounting counter grievances from the far corners of this country.

## U. S. DEFIED IN MESSAGE TO CONGRESS AND MONROE DOCTRINE REJECTED

A defence of Mexico against foreign representations, particularly from the United States, regarding the lives of foreigners and their property, was contained in a message of President Carranza read at the opening session of the Mexican Congress in September. Particular reference was made to alleged injustices practised against Mexicans in the United States.

In the message President Carranza asserted that Mexico did not ask admission to the League of Nations because, he said, the league did not establish equality for all

nations and races. He reiterated that Mexico had not recognized and would not recognize the Monroe Doctrine.

Regarding oil legislation, the message said the government was willing to conciliate, but would not sacrifice its national sovereignty.

#### AMERICAN AVIATOR SHOT BY MEXICANS IN BORDER FLIGHT

Fired upon from the Mexican side of the Rio Grande, Captain David W. McNabb, United States Aviation Corps, was slightly wounded early in September when on aerial patrol duty along the international boundary northwest of Laredo, Texas.

With Lieutenant von de B. Johnson, Captain McNabb was flying slowly up the river close to the water when suddenly a group of Mexicans fired a volley of shots at the airplane, wounding McNabb near the ear. Several shots pierced the plane's wings.

Mexican regret has been expressed by the Mexican government, it was announced subsequently at the State Department. Assurances were given that an immediate investigation would be made with a view to a satisfactory adjustment. Thus is demonstrated again that the pen is mightier than the sword.

The American airplane was "at no time over Mexican territory," the War Department was informed by Major-General Dickman, commanding the Southern Department.

#### ALVARADO WARNS CARRANZA THAT U. S. WILL INTERVENE

Warning Mexicans that intervention by the United States is imminent, General Salvador Alvarado, one of the leaders in the Carranza movement throughout its course, has addressed an open letter to Carranza himself and Generals Obregon and Gonzales, in which he arraigns conditions in Mexico in scathing fashion.

#### MEXICANS KILL AND MUTILATE ANOTHER U. S. CITIZEN

The brutal murder of Herbert S. McGill by bandits at Coapa, Chiapas, Mexico, was reported to the State Department Sept. 8 by the American consul at Vera Cruz.

According to the New York *Tribune* acting Secretary of State Phillips announced that strong representations had been made to the Mexican government to apprehend the bandits, and that instructions had been sent to the American consulate to inform the department fully on all details of the murder.

#### CARRANZA FOES BEG WILSON TO SAVE MEXICO

A proposal on behalf of four of the principal Mexican revolutionary leaders that President Wilson approve the summoning of a conference of all factions for the establishment of a stable government in Mexico on a coalition basis was delivered at the White House by William Gates early in September for transmittal to the President.

The appeal was the result of negotiations that have been under way for some time among the various elements resisting the Carranza régime.

#### U. S. SENATE INVESTIGATING MEXICO

The sub-committee of the Senate charged with investigating the Mexican situation and recommending what shall be done about it consists of Albert B. Fall of the border State of New Mexico, Marcus A. Smith of the border State of Arizona, and Frank B. Brandegee of Connecticut.

This sub-committee of the Foreign Relations Committee is to estimate the indemnity that should be required of Mexico for wrongs suffered by Americans resident in that country; it is to inquire into acts of the Government of Mexico in derogation of the rights of the United States and its citizens; and this committee is to sit in judgment upon Mexico and make proposals for exacting satisfaction from her Government.

#### MEXICAN RETROACTION

The New York *Tribune* gives the following lucid editorial review of the Carranza régime.

To understand the Mexican problem it is necessary to go back to 1913, when Madero, Constitutional President, was deposed and then murdered by military con-

spirators headed by Huerta. Venustiano Carranza, Governor of Coahuila, greatly to his credit, refused to submit to the dictator and took up arms to restore constitutional government, particularly the Juarez constitution of 1857.

The "plan of Guadalupe" outlined the purposes of Carranza and its principles were repeatedly redeclared, for example, in the Declaration of June 15, 1915, wherein Carranza said that his object was to restore the constitution, and that as regards foreigners, residents of or investors in Mexico, the constitutional government would afford them "all the guarantees to which they are entitled under our laws" and "amply protect their lives, their freedom and the enjoyment of the rights of property, allowing them indemnities for the damages which the revolution may have caused to them."

Carranza won, largely because of those pledges, for they brought to him the moral and material support of the United States. Huerta was driven out not so much by the force of Carranza's armies as by the steady pressure of Washington against him. Mexico was turned over to the Mexicans who pretended to stand for freedom and justice, and every American rejoiced in the hope that a troubled neighbor was to have peace.

Instead of keeping his pledges Carranza began immediately to break them. He did not surrender his sword, as Washington did to legally constituted authority, but said it was first necessary to have a new constitution and a new organization. He summoned to Queretaro a company of delegates, named by him, and through them practically decreed a new organic law. The Constitutionalists of Mexico threw the constitution they had fought for into the scrap heap and pretended to establish a new instrument. One of its provisions was that old and long recognized titles should not be valid. Retroactive provisions were inserted, which placed everything at the mercy of the new dictator.

Under the authority alleged to have been conferred a policy of confiscation was embarked on. There was not merely a denial of the right of foreigners to acquire property, but the property they already owned was put at the disposition of Carranza and his group. In the guise of establishing government ownership the government began seizing other people's property. There was only a pretence of compensation. The sums to be allowed were to be fixed by the national and state governments and bonds printed which owners must receive at their face value or get nothing.

The life and fortune of every foreigner were openly delivered into the hands of Carranza. Article 37, of the Queretaro constitution, provides: "The Executive shall have the inclusive right to expel from the republic forthwith *and without judicial process* any foreigner whose presence he may deem inexpedient." So Americans in Mexico have no rights the government is compelled to respect. If they are murdered or robbed—and scores have been—their friends, if they dare protest, are loaded on trains and sent over the border, stripped of all possessions.

Spanish lawyers love metaphysical law, and they have evolved the doctrine that a nation, if it so elects, may make laws retroactive. The argument, naturally, does not appeal to those interested in another legal tradition, a tradition which holds tightly to the doctrine that there are things not even a nation may do. The *ex post facto* doctrine thus revived in Mexico is in essence another expression of the Prussian theory that a state is supermoral and may do anything that it pleases. Carranza has become a dictator as much as Diaz was. He rules with substantially the same iron hand—indeed, his army is larger than the one on which Diaz relied. To the faults of Diaz he adds those of Lenin.

Crises with respect to Mexico are recurrently precipitated by bandit Mexicans doing on their own account that which a bandit government does in the name of the nation. But the banditry of the government is the more important. A situation has been created which cannot forever be endured. Yet so far Mexico as a nation has not divorced herself from responsibility for what is done in her name. If she keeps in power so insistent a pledge-breaker as Venustiano Carranza, a man who has betrayed his promises to Mexico as well as those he made to this country when suppliant for our aid, we shall be unable to remain forever quiescent.

Dr. T. H. Norton, dyestuff expert, in address at American Chemical Society convention in Philadelphia, Sept. 4, stated that after many years of dependence upon Germany for its dyes, America now more than supplies its own needs in artificial colors.

## ENGINEERS AVAILABLE

(Under this heading will be published notes sent to the Secretary of the Institute by members or other persons introduced by members.)

**Works Engineer**, experienced in analyzing underground mining, desires connection with industrial engineering firm; technical graduate; served as mine foreman, superintendent, editor, efficiency engineer. A-3852.

**Metallurgist**. Technical graduate; several years' experience in supervising laboratories and heat-treating plants; well qualified to establish improved methods and facilities for increasing production and eliminating failures in heat treatment of small tools or automobile parts. To be released from Ordnance Department, Sept. 30. A-3995.

**Mining Engineer**, young man, technical graduate, desires position with possibilities for advancement, as assistant superintendent, mine foreman, or engineer. Last position in charge of underground operations lead-silver mine. Fluent Spanish. Well recommended. A-4179.

**Engineer**. Available Sept. 15, as general superintendent or general manager; extended experience in Alaska, Canada, United States and Mexico. Salary \$5000 per year and share interest. A-4590.

**Manager**. Technical graduate; age 29; married; North and South American experience in mining, milling and smelting. Qualified to manage small gold, silver or copper mine. A-4591.

**Mining Engineer**, age 40; married; three years as construction and operating engineer and assistant superintendent with large company; two years superintendent of small lead-silver property; seven years general superintendent large quicksilver property; open for engagement after Oct. 1. Interview Chicago or East. A-4592.

**Lead and Copper Metallurgist**. Technical graduate; released from army; experience as manager in the design, construction and operation of large lead smelter and refinery in Asia; familiar with latest practice in all operations involved in lead and copper smelting, lead refining, treatment of associated metals and byproducts and the design of furnaces and auxiliary equipment. Successfully handled labor problems here and abroad. Available at once. A-4593.

**Metallurgist**, age 30, married. Two and one-half years' experience as foreman in large open-hearth and duplexing plant, and one and one-half years as metallurgist in charge of heat treatment and laboratory, in large steel foundry manufacturing quality castings in carbon, manganese and other alloy steels. A-1 references. A-4594.

**Executive**, forceful and capable. Experienced in large-scale underground and open-pit operations. Skilled in handling men and equipment. Practical experience from mucker to manager. A-4597.

**Technical Graduate**, age 34, married. Experience includes general mining engineering; gold-dredging; flotation testing; mill design; cost keeping; assistant on mine examination; sampling; sample maps; geological maps and reports; superintendent of exploration; development and production. Available on short notice. A-4614.

**Engineer**, age 42, graduate in metallurgy, member Inst. Min. and Met., London; member Australasian Inst. Min. Engrs. Experience in university teaching and research, also industrial investigation work; one year as cement chemist; five years assistant superintendent of large gold-silver mine; special experience in bullion work and electrolytic parting and refining. A-4613.

## POSITIONS VACANT

**Time Study Man.** Young technical graduate, preferably M. E., for position as time study man and rate setter. New York State. R-1539.

**Sales Engineer.** A high-grade man to handle a line of dredging machinery. Pennsylvania. R-1530.

**Chief Engineer.** Competent engineer to take charge of engineering department and drafting room. Thorough experience in modern methods employed in elevating, conveying and handling of all kinds of material, and designing of machinery used for such purposes; also a thorough knowledge of machinery, and its application, for the mechanical transmission of power. Salary depends upon man. California. R-1529.

**Research Engineer.** Recent graduates with a few years' experience in research and design for work on welding parts. Technical graduates preferred. New Jersey. R-1528.

**Lubrication Engineer** to advise regarding correct use of lubrication for a copper refining plant employing 1500 men. Considerable amount of mechanical equipment including motors, generators, cranes, rolling stock, blowing engines, etc. Must be able to develop system of inspection so as to improve qualities of materials purchased each year and their methods of application, in order to save on machine repairs. Must be somewhat trained in chemistry, in order to write oil specifications and intelligently interpret results of tests to see whether oils check up to requirements. New Jersey. R-1525.

**Sales Engineer.** Young man, preferably M. E., a keen thinker, as well as persistent worker. Opportunity is limited only by ability demonstrated; right man can make this his life work. Character references required. State experience fully and remuneration expected at start. New York. R-1523.

**Hydraulic Engineer.** To sell hydraulic presses. Must have had extensive experience in hydraulic engineering, and be used to heavy machinery; must be acquainted in Pittsburgh district. R-1501.

**Factory Executive.** Engineer experienced in melting of brasses and bronzes with oil-fired reverberatory furnaces. New Jersey. R-1487.

**Factory Foreman** experienced in Wilfley tables and ball mills, melting and concentration work; chemical experience not essential. New Jersey. R-1486.

**Metallurgist** to be the head of a laboratory for research work. Familiar with metallographic work on steel. Responsible position. Philadelphia. R-1477.

**Recent Graduates** in mining engineering for positions in South America. Good location. Salary \$125 per month. R-1456.

**Geologist.** Young engineer to follow up the geological formation encountered in the course of development and to do the necessary surveying and assaying work. Arizona. R-1430.

**Mining Engineer** to examine copper property and report on its formation and to give advice as to the necessary work for its future development. Only competent man considered for this purpose. Arizona. R-1429.

**Mining Engineer** with experience in metallurgical work, for position with United States Tariff Commission. Washington, D. C. R-1476.

## INTERALLIED CHEMICAL FEDERATION

The second Interallied Conference of Chemical Associations was held in London, July 14 to 18. Delegates from the allied countries were present, the delegates from the United States being Dr. Frederick G. Cottrell, Dr. Charles L. Parsons, Dr. Edward W. Washburn, and Dr. Robert Ruttan.

During this conference, the Interallied Chemical Federation was formed, and the following were named as officers: President: Charles Moureu. Vice-presidents: Messrs. Chavanne, Parodi-Delfino, Charles Parsons and Sir William Pope. General Secretary: Jean Gerard.

The Federation named Paris as provisional headquarters, and arranged to hold its next conference in Rome, in June, 1920.

## NATIONAL SECURITY LEAGUE PUBLICATIONS

The National Security League (19 W. 44th St.), New York City, has published recently the following interesting and valuable patriotic documents. Copies can be obtained free (except where price is given) upon request enclosing two-cent stamp.

War Facts and Peace Problems, By Dr. Arthur L. Frothingham, 256 pp. Price 25 cents.

Our Charter of Liberty, 96 pp.; A series of articles explaining the Constitution of the United States, prepared for the celebration of "Constitution Day," September 17, 1919, by James M. Beck, Westel Woodbury Willoughby, Julius M. Mayer, Henry Litchfield West, William Franklin Willoughby, Robert McNutt McElroy and William M. Wiley.

A Catechism of the Constitution of the United States; By Henry Litchfield West, 16 pp.

Socialism and Bolshevism; By J. L. Montgomery, 8 pp.

Capital and Labor, a Fair Deal; By Otto H. Kahn, 16 pp.

Militia; By Col. Charles E. Lydecker, 16 pp.

Annual Report of the National Security League; By Col. Charles E. Lydecker, President, 12 pp.

The Enemy within our Gates, Bolshevism's Assault upon American Government; By Henry Campbell Black, LL.D., 28 pp.

Is America Worth Saving?; By Dr. Nicholas Murray Butler, President of Columbia University, 24 pp.

The Essential Elements of a Good Budget System for the United States; By Charles Wallace Collins, 16 pp.

Eighty thousand copies of "A Catechism of the Constitution of the United States," by Henry L. West, have been printed by the League. 5,000 individual letters requesting copies have been received at League Headquarters, showing its popularity. It is being published in serial form as an editorial feature in more than twenty-five daily newspapers and has proved most useful in classes where Americanization of persons of foreign birth is being attempted.

Argentina now is among eight largest customers of the United States. Statistics show that trade between the two countries during the 12 months ended June 30 amounted to \$304,000,000.

# PERSONAL

The following is an incomplete list of members and guests who called at Institute headquarters during the period Aug. 10, 1919, to Sept. 10, 1919.

- |                                     |  |
|-------------------------------------|--|
| Elfred Beck, Lincoln, Neb.          | L. Ray Lane, Havana, Cuba.             |
| R. S. Botsford, Petrograd, Russia.  | H. O. Lange, Chicago, Ill.             |
| R. S. Burdette, Akron, Ohio.        | John H. Leavell, Salt Lake City, Utah. |
| P. P. Butler, Douglas, Ariz.        | J. H. Ledeboer, The Hague, Holland.    |
| F. D. Carnes, Lincoln, Neb.         | H. R. Leonard, Harrisburg, Pa.         |
| C. A. Cheney, Madison, Wis.         | G. B. Marshall, Costa Rica.            |
| W. M. Corse, Mansfield, Ohio.       | T. Poole Maynard, Atlanta, Ga.         |
| T. B. Counselman, Duluth, Minn.     | W. C. Phalen, Washington, D. C.        |
| E. S. Dickinson, Iron Mt., Mich.    | Fred S. Porter, Seattle, Wash.         |
| N. H. Emmons, 2d, Boston, Mass.     | J. C. Ray, Palo Alto, Calif.           |
| Thos. E. Fisher, New York City.     | Harold Rickard, London, Eng.           |
| F. N. Flynn, Newark, N. J.          | H. Sato, Tokio, Japan.                 |
| A. H. Garner, Astoria, Ore.         | Richard M. Sanchez, Tarma, Peru.       |
| Capt. Nelson B. Gatch, U. S. Army.  | Carl Scholz, Chicago, Ill.             |
| F. A. Glass, Brainerd, Minn.        | Mrs. Carl Scholz, Chicago, Ill.        |
| T. G. Hawkins, Jr., El Paso, Tex.   | C. Kenneth Smullen, Baltimore, Md.     |
| Ruger W. Hay, Easton, Pa.           | W. G. Swart, Duluth, Minn.             |
| Lieut. James L. Head, U. S. Army.   | Richard H. Vail, New York City.        |
| B. B. Hood, Chrome, N. J.           | Capt. Allan G. Waite, Boston, Mass.    |
| W. E. Hopper, Washington, D. C.     | Olof Wenstrom, Boston, Mass.           |
| Robert M. Keeney, Denver, Colo.     | P. T. Williams, San Francisco, Calif.  |
| S. M. Keiper, New York City.        | J. H. Winwood, Salt Lake City, Utah.   |
| Raymond B. Ladoo, Washington, D. C. | Henry Wolf, Denver, Colo.              |

**J. Andrew B. Armstrong**, formerly of Danbury, Conn., is now at Holguin, Cuba.

**Harold Boericke**, who has been with the Primos Exploration Co. at Boulder, Colo., has been transferred to Primos, Pa.

**F. A. Dalburg**, recently with the Humble Oil and Refining Co. at Ranger, Tex., has accepted a position with the National Coal Co., at Manila, P. I.

**George C. Dewey**, lately in the U. S. Army, is now chemist and assayer with the Selby Smelting and Lead Co., at Selby, California.

**N. H. Emmons, 2d**, has removed from Lynchburg, Va. to Boston, Mass.

**R. E. T. Haff**, formerly with E. I. du Pont de Nemours & Co. at Wilmington, Del., has accepted a position with the Cadillac Motor Car Co. at Detroit, in the plant extension department.

**H. G. Hilton**, who has been with the United Furnace Co. at Canton, Ohio, is now connected with the Steel Company of Canada, at Hamilton, Ont.

**J. Parke Hood**, recently discharged from the army, has accepted a position with the Grasselli Powder Co. as agent in the Southern anthracite coal region, with an office in Pottsville, Pa.

**K. K. Hood**, with the American Zinc Lead and Smelting Co., has been transferred to the American Zinc Co. of Tennessee, at Mascot, Tenn.

**E. P. Humphrey**, who has occupied the position of assistant superintendent of the Upper Lehigh and the Wentz coal companies at Finland, Pa., has been made superintendent of the J. S. Wentz Co., Hyde Brook mine, Upper Lehigh, Pa.

**George W. Lucas**, who is in the Engineering Department of the Roxana Petroleum Co., has been transferred from Tulsa to St. Louis.

**Dorsey A. Lyon**, of the U. S. Bureau of Mines, has been transferred from Pittsburgh to Washington, D. C.

**H. T. Marshall** has resigned as chief engineer of the Nevada Consolidated Copper Co. and has accepted a position as mining engineer for the Inspiration Consolidated Copper Co. at Inspiration, Arizona.

**Ezequiel Ordenez** has opened an office as consulting mining geologist and engineer at Room 24, Isabel la Catolica 25, Mexico City.

**G. M. Ponton**, since returning from an extended trip to British Columbia, has been appointed Assistant Secretary to the Canadian Trade Commission.

**M. F. Quinn** has removed from Hillsboro, New Mexico, to Salt Lake City, Utah.

**Max Roesler** has completed his work with the U. S. Geological Survey and has returned to New York City.

**J. J. Sandford**, formerly with the Bunker Hill and Sullivan Mining & Concentrating Co., is now with the B. & A. Mining Co., Gillham, Arkansas.

**Charles H. Schmalz** has accepted a position as assistant factory manager of the Holt Mfg. Co., at Peoria, Ill. Mr. Schmalz was with the Hanna Engineering Works, in Chicago.

**Charles Eugene Schneider**, of the Creuzot Works, France, who last spring was awarded the gold medal of the Mining and Metallurgical Society, is visiting this country as a member of the Allied Trades Commission.

**John S. Stewart** has removed from Mansfield, Ohio, to Kellogg, Idaho.

**H. H. Stout**, formerly superintendent of the Nichols Copper Co., has been appointed superintendent of the Copper Queen smelter at Douglas, Arizona.

**A. P. Stramler**, having been discharged from the army, has accepted a position with the Texas Pacific Coal and Oil Co., at Ranger, Texas.

**Arthur F. Taggart** and **R. B. Yerxa** have formed a partnership under the name of Taggart and Yerxa, and have opened a testing and analytical laboratory at 165 Division St., New Haven, Conn.

**Edward O. Werba** has accepted a position with the Meriden Iron Co. at Hibbing, Minnesota.

**Hallett Winmill** is leaving England this month, to take a position at Winnebar, Gold Coast, Africa.

**T. A. Wilson** has been appointed general manager of The Arizona Hercules Copper Company, at Ray, Arizona.

**Harry M. Ziesemer**, who has recently been discharged from the army, has returned to his position with the Copper Queen Branch of the Phelps-Dodge Corp., where he is now chief engineer.

## MEMBERSHIP

## NEW MEMBERS

The following list comprises the names of those persons who became members during the period Aug. 10, 1919, to Sept. 10, 1919.

- ABEL, ALBERT E. . . . . Gen'l Supt., Valley Mould & Iron Corp., Sharpsville, Pa.  
 ATCHERSON, R. W. H., Blast Furnace Supt., Inland Steel Co.,  
 Indiana Harbor, Ind.  
 BAKER, CHARLES LAURENCE, Geol. . . . . 2320 Hilgard Ave., Berkeley, Cal.  
 BAKEWELL, DONALD C., Pres., Duquesne Steel Foundry,  
 Farmers Bank Bldg., Pittsburgh, Pa.  
 BALDWIN, ALLEN T., Supervisor of Battery Factories,  
 Manhattan Electrical Supply Co., Inc., 45 Morris St., Jersey City, N. J.  
 BARKELL, FRED. A., Min. Engr., Central Coal & Coke Co.,  
 215 Globe Bldg., Pittsburg, Kan.  
 BIERCE, ERNEST C., Met. Engr., Kennard & Bierce,  
 85 North Orange Grove Ave., Pasadena, Cal.  
 BOHN, W. C. . . . . Gen'l Mgr., Fairview Fluorspar & Lead Co., Rosiclare, Ill.  
 BRABROOK, GEORGE HALE . . . Mgr., Cascade Silver Mines & Mills, Neihart, Mont.  
 BRADSHAW, HAMILTON, Director, Experimental Station,  
 E. I. du Pont de Nemours & Co., Wilmington, Del.  
 BRAY, THOMAS JOSEPH . . . . . Pres., Republic Iron & Steel Co., Youngstown, O.  
 BROWN, C. ARTHUR, Chief Engr., Engrg. Bureau Water Purification,  
 30 Church St., New York, N. Y.  
 BUCK, DANIEL M., Met. Engr., American Sheet & Tin Plate Co.,  
 1328 Frick Bldg., Pittsburgh, Pa.  
 CAIN, FRANK D. . . . . Engr., St. Bernard Min. Co., Earlington, Ky.  
 CHANCE, THOMAS MITCHELL, Cons. Min. Engr., H. M. Chance & Co.,  
 835 Drexel Bldg., Philadelphia, Pa.  
 CONNELL, H. R. . . . . Research Engr., General Electric Co., Schenectady, N. Y.  
 COREY, C. R. . . . . Asst. Prof. of Met., Univ. of Washington, Seattle, Wash.  
 CRUMBAUGH, JOHN J., Valuation Engr., United Shipping Board,  
 140 N. Broad St., Philadelphia, Pa.  
 CUSHMAN, ALLERTON S. . . . . Pres., Institute of Industrial Research, Washington, D. C.  
 DETWEILER, M. H. . . . . Chief Engr., Union Colliery Co., Du Quoin, Ill.  
 DRESSER, CARL K., Pres., National Resources Development Corp.,  
 54 Boylston St., Bradford, Pa.  
 EIRICH, CONSTANCE GRACE (Miss), Pet. Geol., Gypsy Oil Co., Box 1212, Tulsa, Okla.  
 GARDNER, ROYAL DUNCAN . . . . . Foreman, Walter Fitch, Jr. Co., Eureka, Utah.  
 GARFIAS, VALENTINE RICHARD, Geol. & Civil Engr., Henry L. Doherty & Co.,  
 60 Wall St., New York, N. Y.  
 GEISE, WILLIAM B. . . . . Div. Engr., Susquehanna Collieries Co., Shamokin, Pa.  
 GRIFFITHS, WILLIAM, Smelter Statistician, Granby Consolidated Min.,  
 Smelt. & Power Co., Ltd., Anyox, B. C., Canada.  
 HALLSTED, JAMES C., Civil Engr., Robert W. Hunt & Co.,  
 2200, 175 W. Jackson Boulevard, Chicago, Ill.  
 HERIVEL, P. A. . . . . Assayer, Penn Mex. Fuel Co., Apartado 115, Tampico, Mexico.  
 HOHL, GEORGE M., Asst. Supt. of Blast Furnaces, Bethlehem Plant,  
 Bethlehem Steel Co., Bethlehem, Pa.  
 JASBERG, O. J. . . . . Min. Engr., The Smuggler-Union Min. Co., Telluride, Colo.  
 JOHNSON, GUY J. . . . . Min. Engr., Safety Engr., Homestake Min. Co., Lead, So. Dakota.  
 KAIM, HENRY J., Vice-pres. & Treas., Union Brass & Metal Mfg. Co., St. Paul, Minn.  
 KEEN, WILLIAM HERBERT, Factory Mgr., U. S. Copper Products Corp.,  
 3511 Ridge Road, S.W., Cleveland, Ohio.  
 KIRKPATRICK, ROBINSON R., Min. Engr., The Gauley Mountain Coal Co.,  
 Ansted, Fayette Co.; W. Va.  
 KNICKERBOCKER, ARTHUR K. . . . . Supt., Northern Minnesota Ore Co., Cuyuna, Minn.  
 KRYNITZKY, ALEXANDER JOHN, Met., Asst. Physicist,  
 Bureau of Standards, Washington, D. C.  
 LANGE, H. O., Pres., Ferguson & Lange Foundry Co.,  
 Clybourn Ave. & Willow St., Chicago, Ill.  
 LEE, R. L. . . . . Smelter Supt., Arizona Smelt. & Power Co., Benson, Ariz.

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS xliii

- LEONARD, REGINALD W., Min. Engr., Leonard Engrg. Co., 1119 Main St., Boise, Idaho.  
 McCASKELL, G. W., Supt., Deer Trail Min. Co., Marysville, Utah.  
 MALINOVSKY, ANDREW, Chem. Engr., The Malinite Co.,  
 316 Portland Ave., Belleville, Ill.  
 MATHEWS, P. L., Plant Supt., International Coal Products Corp.,  
 150 Shaw Ave., Irvington, N. J.  
 MURRIE, JOHN LESTER, Cons. Engr., Murrie & Co., 74 Broadway, New York, N. Y.  
 NEWTON, J. G., Met. Supt., Cerro de Pasco Copper Corp., La Fundicion, Peru, S. A.  
 NICHOLAS, THOMAS J., Mine Supt., Cascade Min. Co., Palmer, Mich.  
 NORTON, JAMES THOMAS, Ore Dressing Engr.,  
 United States Bureau of Mines, Moscow, Idaho.  
 PHYTHON, HARRY, Inspector of Mines,  
 Commonwealth of Pennsylvania, Belle Vernon, Pa.  
 SACKETT, BLAIR LIVINGSTON, Supt., Lead Plant,  
 International Smelt. Co., Box 140, Tooele, Utah.  
 SAKLATWALLA, BERAM D., Gen'l Supt., American Vanadium Co., Bridgeville, Pa.  
 SHOLES, CHARLES ESTE, Vice-pres. & Gen'l Mgr.,  
 Edison Storage Battery Co., Orange, N. J.  
 SILL, RUSH T., Cons. Min. Engr., Engr. of Mines, Sill & Sill,  
 1011 South Figueroa St., Los Angeles, Cal.  
 SMITH, ALBERT WILLIAM, Asst. Supt., Steel Plant,  
 Youngstown Sheet & Tube Co., Youngstown, O.  
 SNOW, FRED A., Pres., The Fred A. Snow Co., 1942 W. Kinzie St., Chicago, Ill.  
 SOMERVILLE, J. S., Gen'l Mgr., Rockhill Iron & Coal Co., Robertsdale, Pa.  
 SOUTHWARD, GLENN B., Chief Engr., West Virginia Coal & Coke Co., Elkins, W. Va.  
 STOKES, RUPERT O., Mech. Engr., The Dorr Co., London Office,  
 16 South St., London, E. C. 2, England.  
 TAYLOR, JOSEPH McFERRAN, Chief Engr., Utah Apex Mine, Utah Apex Min. Co.,  
 Bingham Canyon, Utah.  
 THOMPSON, ARTHUR BEEBY, Cons. Engr., A. Beeby Thompson & Partners,  
 18 St. Swithin's Lane, London, E. C. 4, England.  
 WHITE, KESSACK D., Pet. Geol., Room 1300, 66 Liberty St., New York, N. Y.  
 WHITEHURST, JOHN W., 100 Pope Block, Box 525, Pueblo, Colo.  
 WHITWELL, E. V., Geol., Carter Oil Co., Tulsa, Oklahoma.

## Associates

- ARATA, C. C., Supt., Pittsburgh-Jerome Copper Co., Box N, Jerome, Ariz.  
 ARCHER, ROBERT S., Met., Lynite Laboratories, Aluminum Castings Co.,  
 2800 Harvard Ave., Cleveland, O.  
 BAGLEY, EARLE M., Mill Foreman, United Eastern Min. Co., Oatman, Ariz.  
 BALL, WILLIAM H., Coal & Coke Agent, Semet-Solvay Co., Syracuse, N. Y.  
 BECK, ELFRED, Oil Geol., Gypsy Oil Co., Box 1212, Tulsa, Okla.  
 BERGSTROM, FRANK S., Min. Engr., Cascade Min. Co., Palmer, Mich.  
 BOERICKE, E. R., Investigation of Mineral Deposits, Foreign Cruiser,  
 Primos Chemical Co., Boulder, Colo.  
 CARNES, FOSS D., Min. Engr., 1924 Q St., University Place, Nebraska.  
 CHILD, RALPH S., Pres., Marquette Iron Co., 5 Nassau St., New York, N. Y.  
 CRAIG, ERNEST G. L., Research Engr., Scovill Mfg. Co., 99 Mill St., Waterbury, Conn.  
 EDDY, ARTHUR E., Min. Engr., Anaconda Copper Min. Co.,  
 110 North Washington St., Butte, Mont.  
 EELLS, WILLIAM E., Mgr. of Smelter, Cia. Metalurgica Mexicana,  
 Apartado 132, San Luis Potosi, Mexico.  
 GAZARIAN, LEON G., Engr., Oliver Continuous Filter Co.,  
 299 Madison Ave., New York, N. Y.  
 GIRARD, F. J., Foreman of Cyaniding Mill, Cornucopia Mines Co.,  
 Cornucopia, Ore.  
 HAYDEN, WILLIAM F., Mine Operator, Greensburg, Pa.  
 KELLY, SHERWIN FINCH, Asst. Geol., Tri-State Geol. Survey,  
 Chamber of Commerce, Joplin, Mo.  
 KENDALL, GEORGE H., Cashier, St. Louis Smelt. & Refin Co., Collinsville, Ill.  
 McCLOURE, FRANK G., Min. Engr., Phelps-Dodge Corp.,  
 Copper Queen Branch, Bisbee, Ariz.  
 METGER, J. C., Shift Boss, Timber Butte Milling Co., Butte, Mont.

NEWCOMB, CLIVE W. . . . . Nitrate Industry, Cailla 232, Iquique, Chile.  
 ROY, WILLIAM A., Supt., Compania De Combustible "Agujita" S. A.,  
 Apartado 34, Sabinas, Coah., Mex.  
 SIMPSON, GERALD R. . . . . Supt., Standard Minerals Co., Anaheim, Cal.  
 SMITH, RICHARD RAYMOND, Min. Engr., Phelps-Dodge Corp.,  
 Copper Queen Branch, Box 2512, Bisbee, Ariz.  
 TRACY, DAVID E., Pres., Harrisburg Pipe & Pipe Bending Co.,  
 Front & Muench Sts., Harrisburg, Pa.  
 VAN BURGH, LISLE R. . . . . Geol., Frautz Corp., Box 1074, Casper, Wyo.  
 WADE, HENRY H., Met., Minnesota School of Mines, Experiment Station,  
 Minneapolis, Minnesota.

### *Junior Associates*

ABORN, ROBERT H. . . . . Student, Mass. Inst., Sheldon, Iowa.  
 BOHANON, HAROLD J. . . . . Student, State College of Washington, Pullman, Wash.  
 BRAZILL, MATTHEW P., JR. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 BURFORD, C. P. . . . . Student, Missouri School of Mines, Box 714, Rolla, Mo.  
 COLBERT, JULES PHILIP . . . . . Student, Missouri School of Mines, Rolla, Mo.  
 CORNWELL, BENJAMIN SEDGELY . . . . . Student, Missouri School of Mines, Rolla, Mo.  
 DEANE, JOSEPH TENISON . . . . . Student, University of California, Berkeley, Cal.  
 DONOGHUE, EARL M., Asst. Met., The Park Drop Forge Co.,  
 1407 E. 111 St., Cleveland, O.  
 ENGEL, ABRAHAM L., Technical Man, Research Dept., Anaconda Reduction Works,  
 508 Locust St., Anaconda, Montana.  
 ESTERLY, JOHN E. . . . . Student, Pennsylvania State College, State College, Pa.  
 FOPEANO, LOUIS C. . . . . Student, Colorado School of Mines, Golden, Colo.  
 GERBER, C. O. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 HARDY, EARL B. . . . . Student, Colorado School of Mines, Golden, Colo.  
 HUGHES, HARRY H., JR. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 INMAN, WILLIAM ELLIOTT, Teaching Fellow, University of California, Berkeley, Cal.  
 IRWIN, ARTHUR L. . . . . Student, Univ. of Toronto, Toronto, Ont., Canada.  
 JACOBS, MORRIS FISHEL, Student, South Dakota State School of Mines,  
 Rapid City, So. Dakota.  
 KING, CLARENCE RIGG . . . . . Student, University of California, Berkeley, Cal.  
 LONG, CARL THOMPSON . . . . . Student, University of California, Berkeley, Cal.  
 McMILLEN, FRANK M. . . . . Missouri School of Mines, Rolla, Mo.  
 MILLS, OLIVER A. . . . . Student, Massachusetts Institute of Tech., Cambridge, Mass.  
 MORGAN, F. A. JR. . . . . Student, University of California, Berkeley, Cal.  
 MORRIS, THOMAS CARSON . . . . . Farmington, Mo.  
 MUTZ, HERMAN J. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 O'BRIEN, GLEN THOMAS . . . . . Student, University of California, Berkeley, Cal.  
 PASCOE, HUBERT LEONARD . . . . . Student, University of California, Berkeley, Cal.  
 ROGERS, KENNETH A., Engr., Flint Development & Construction Co., Flint, Mich.  
 SCHNEIDER, GEORGE W. . . . . Student, Colorado School of Mines, Golden, Colo.  
 SCHULTZ, HARRY C., Miner, Bunker Hill & Sullivan Min. & Concentrating Co.,  
 Kellogg, Idaho.  
 STETLER, HARRY F., Engr., Pennsylvania Public Service Corp., Johnstown, Pa.  
 STEWART, WILLIAM LINCOLN, JR. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 SWAYZE, RONALD O. . . . . Student, Missouri School of Mines, Rolla, Mo.  
 TRESCHER, FERDINAND G. . . . . Student, University of California, Berkeley, Cal.  
 YATES, ARTHUR B. . . . . Student, University of California, Berkeley, Cal.

### *Change of Status, Junior Associate to Member*

BURROUGHS, A. H., JR. . . . . Armstead Mines Inc., Talache, Idaho.  
 CARPENTER, CLARK B. . . . . Girard, Kansas.  
 WHITTIER, W. H. . . . . Medford, Ore.

### *Change of Status, Associate to Member*

PARTRIDGE, GUY WARREN, Assayer, American Smet. & Refin. Co.,  
 Apartado 101, Monterrey, N. L., Mexico.  
 RUNYON, WALTER C. . . . . Scarsdale, N. Y.  
**Total Membership, Sept. 10, 1919. . . . . 7616**

## MEMBERS' ADDRESSES WANTED

| Name.                              | Last address of Record from which Mail has been returned.  |
|------------------------------------|--|
| ANDERSON, L. W.                    | Boston Mine, Utah Copper Co., Bingham, Utah.   |
| ARMSTRONG, E. W.                   | Mina Bibilonia, La Libertad, Nicaragua, C. A.  |
| BIRD, FRANK H.                     | Butler Hotel, Seattle, Wash.   |
| BREEDING, F. O.                    | Eden Min. Co., Bluefields, Nicaragua.  |
| BROWN, W. SINCLAIR                 | Air Board Offices, Swansea, England.   |
| CALLEN, ARTHUR S.                  | 3510 N. 16th St., Philadelphia, Pa.  |
| CAMPBELL, W. C.                    | Care Ivanpoh Min. Co., Cima, Cal.  |
| CRONIN, PAUL B.                    | 1453 Oak St., Glendale, Cal.   |
| DETERT, WILLIAM F.                 | Jackson, Amador Co., Cal.  |
| DONAHOE, JOHN E.                   | Connecticut Zinc Corp., Oronogo Circle Mines, Oronogo, Mo.   |
| EISSLER, MANUEL                    | Hong Kong Club, Hong Kong, China.  |
| FLAHERTY, ROBERT H.                | 74 King St., E., Toronto, Ont., Canada.  |
| GLEASON, VILLEROY, JR.,            | Machinery Dept., Mine & Smelter Supply Co.,<br>121-125 West 2d So. St., Salt Lake City, Utah.      |
| HERR, J. CAMPBELL                  | Box 556, State College, Pa.  |
| HERZIG, C. S.                      | Care George B. Herzig, 41 West 29th St., New York, N. Y.   |
| KAMMERER, CHARLES                  | Box 412, San Francisco, Cal.   |
| KAY, DAVID NELSON                  | Ray Cons. Copper Co., Hayden, Ariz.  |
| KING, FRANK E.                     | Hotel Breslin, New York, N. Y.   |
| KLUGESCHIED, WALTER P.             | 616 W. 13th St., New York, N. Y.   |
| LEVAT, DAVID                       | 174 Blvd. Malesherbes, Paris, France.  |
| McLINTOCK, A.                      | Hermon, St. Lawrence Co., N. Y.  |
| MATTHIAS, MAXIMILIAN PAUL, Lieut., | Ordnance Dept., U. S. A.,<br>194 Nesmith St., Lowell, Mass.  |
| MINISTER, H. L.                    | The Empire Zinc Co., Kelly, N. Mex.  |
| NAHL, A. C.                        | 1079 Monadnock Bldg., San Francisco, Cal.  |
| NIEMAN, HENRY W.                   | 27 West 44th St., New York, N. Y.  |
| PORTER, JAMES CLARKE, Mgr.,        | Coal Exploration Dept., E. J. Longyear Co.,<br>413 National Bank of Commerce Bldg., St. Louis, Mo. |
| ROWE, FREMONT S.                   | Supt., Hecla Mine, Burke, Idaho.   |
| SCHNEPP, C. F.                     | 307 S. Club Walk, Pennsgrove, N. J.  |
| STICKNEY, WILLIAM H.               | 708 N. Center St., Reno, Nev.  |
| THOMSON, S. C.                     | War Export Board, Hotel Burlington, Washington, D. C.  |
| TINGLEY, T. W.                     | Beutree, W. Va.  |
| WOO, W. K.                         | M 70 Sing Kong Li, Minghong Road, Shanghai, China.   |
| WRIGHT, FREDERICK S.               | Supt., Butte & Great Falls Min. Co., Neihart, Mont.  |

## NECROLOGY

The deaths of the following members were reported to the Secretary's office during the month Aug. 10, 1919, to Sept. 10, 1919.

| Date of Election. | Name.            | Date of Death. |
|-------------------|------------------|----------------|
| 1888              | CARNEGIE, ANDREW | Aug. 11, 1919. |
| 1917              | GODBE, RALPH T.  |                |
| 1903              | COOPER, JOHN     | June 17, 1919. |
| 1913              | HINCKLEY, E. R.  | 1918.          |

## CANDIDATES FOR MEMBERSHIP

**APPLICATION FOR MEMBERSHIP.**—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any persons whom they think should not be classified in accordance with the list given.

*Applications Lacking Endorsement*

Applications for membership have been received from Mr. Humenry and Mr. Sorenson, whose records are given below. These applications

lack the necessary number of endorsers, but since these candidates live at some distance from the headquarters of the Institute, their records are published here in order that any members who are acquainted with them may be advised of the circumstances and may have an opportunity of writing to the Secretary endorsing these candidates.

**Joseph Humenry**, Douai, France.

Present position—1918 to date: Director of the service of grouping the colliery victims of the invasion.

Proposed by Arthur H. Wethey.

Born 1874, Aurillac, France. 1911-17, Engr. of Mines in Dasreville & Anrin. 1907-14, Principal Engr. of Mines of Liévin. 1914, Chief Engr. of Mines of Liévin.

**James Sorenson**, Clintonville, Wis.

Present position—1918 to date: Met. Engr., Four Wheel Drive Auto Co.

Proposed by

Born 1890, Racine, Wis. 1908-09, Racine College of Commerce. 1910-12, Chicago Technical College. 1915, Iron & Steel Analysis, Marquette Univ. 1914-17, Met., Gemco Mfg. Co., Milwaukee, Wis. 1917-18, Engr. of Tests, Cannon Forgings, U. S. Army.

The following persons have been proposed during the period Aug. 10, 1919, to Sept. 10, 1919, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

### *Members*

**Alan Audrey Andrew**, Transvaal, S. Africa.

Present position: Mgr., Maid-of-De-Kaap Gold Min. Co.

Proposed by W. A. Caldecott, F. Wartenweiler, P. M. Newhall.

Born 1882, Pinetown, Natal, S. A. 1893-96, School of Durban, Natal. 1896-98, Colwyn Bay, Dinglewood, N. Wales. 1898-99, Learner, Alundi Gold Min. Co. 1902-03, Retirement wks. 1903-08, Cyanide Mgr., Horo gold mine. 1908-09, Cyanide Mgr., Forbes Refin. Gold Min. Co. 1910-12, In full charge, Kobolendo Gold Min. Co. 1912-14, In full charge, Aurora Gold Min. Co. 1914-15, In full charge, Maid of the Mist Gold Mine Co. 1914, 3 mos. military service. 1916-17, In service. 1917-19, Maid-of-De-Kaap Gold Min. Co.

**Elmer Lawrence Andrews**, Lima, O.

Present position—1917 to date: Engr., Trunk Lines, Northern Group of Pipe Lines, Indiana Pipe Line Co.

Proposed by John G. Pew, W. H. Dufur, Forrest M. Towl.

Born 1874, Lima, O. Public & High Schools, Lima, O. No college training. 1891-94, Draftsman, J. A. Chapin, Architect, Lima, O. 1894-99, Draftsman, Transitman, Asst. Engr., City Engrs. Office, Lima, O. 1899-1901, Engr. Draftsman, Ohio Oil Co., Oil City, Pa. 1901-07, Asst. Engr., National Transit Co., Oil City, Pa. 1907-12, Asst. Engr., National Transit Co. 1912-13, Engr., Indian Pipe Line Co., Montpelier, Ind. 1913, Engr., Imperial Oil Co., Sarnia, Ont., Canada. 1913-17, Engr., Indiana Pipe Line Co., Montpelier, Ind.

**Lawrence L. Arnold**, Buffalo, N. Y.

Present position—1908-19: Gen'l Supt., Wickwire Steel Co.

Proposed by Willard H. Nash, Palmer C. Ricketts, Roger Taylor.

Born 1877, Indianapolis, Ind. Private schools. 1899, Grad., Rensselaer Poly. Inst., B. S. 1899-1901, Chem.; 1901-03, Asst. Supt., Blast Furnace; 1903-06, Supt., Blast Furnace, Jones & Laughlin Steel Co. 1906-08, Supt., Clairton Furnaces, Carnegie Steel Co., Clairton, Pa.

**John Atkinson, Emmaville, N. S. W., Australia.**

Present position—1912 to date: Mgr., Vegetable Creek Tin Min. Co., Emmaville, N. S. W.

Proposed by George Smith, Wm. H. Corbould, G. H. Blakemore.

Born 1884, Durham, England. 1903-06, Sydney Univ., E. M. & M. 1909, Surveyor, Acct. & Assayer, Cadia Copper Min. Co. 1909-10, Acct. & Assayer, Bodangra Gold Min., Wellington. 1910-12, Asst. Works Mgr., Great Cobar, Ltd.

**Frederick Mark Becket, Niagara Falls, N. Y.**

Present position—1906 to date: Chief Met., Electro Metallurgical Co. & Union Carbide Co.

Proposed by F. J. Tone, F. Austin Lidbury, C. E. McQuigg.

Born 1875, Montreal, Canada. 1891-95, McGill Univ. 1898-99, Columbia Univ. 1900-02, Columbia Univ. 1895-96, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa. 1896-98, Experimental work, Charles E. Acker, Jersey City, N. J. 1899-1900, Ex. wk., Acker Process Co., Jersey City, N. J. & Niagara Falls, N. Y. 1902-03, Ex. wk., Ampere Electrochemical Co., Niagara Falls, N. Y. 1903-06, Cons. Met., Niagara Research Laboratories.

**Richard Beer, Carbondale, Pa.**

Present position: Colliery Supt., Clinton Colliery, Hudson Coal Co., Vandling, Pa.

Proposed by R. Y. Williams, R. H. Buchanan, Charles Dorrance.

Born 1854, Fremington, England. 1861-64, Schools, Fremington, England. 1864-66, Sketty, Wales. 1872-77, Miner, steam coal mines, Wales. 1877-80, Miner, coal mines, So. Staffordshire, England. 1880-89, Miner, Anthracite coal mines of Pa., Lehigh Valley Co., Hillside Coal & Iron Co., Avoca Florence Coal Co Dupont, Pa. 1889-93, Mine Foreman, Columbia Coal Co., Duryea, Pa. 1893-97, Mine Foreman, Elk Hill Coal & Iron Co., Pa. 1897-1907, Mine Foreman, Coal Dept., Del. & Hudson Co. 1907-19, Div. Foreman, & Div. Supt., Asst., Hudson Coal Co.

**George Magruder Berry, Syracuse, N. Y.**

Present position—1905 to date: Chief Chem., Halcomb Steel Co.

Proposed by J. D. Pennock, H. P. Bellinger, Edward N. Trump.

Born 1879, near Leonardtown, St. Mary's Co., Md. 1899, George Washington Univ., B. S. 1899-1903, Chem., Park Steel Co., Met. & Analysis. 1903-04, Chem., Willsen Aluminum Co. 1904-05, Cons. Chem., Wyckoff, Scamans & Benedict. 1916 to date, Syracuse Univ., lecturer on met.

**G. William Bjorkstedt, Bayonne, N. J.**

Present position: Met., Bayonne Steel Casting Co.

Proposed by A. H. Jameson, W. D. Sargent, S. N. Castle.

Born 1882, Trollhåtan, Sweden. 1902-07, Royal Tech. High School, Stockholm, Sweden, M. E. 1907-09, Chem., Noble Elec. Steel Co., Heroult, Calif. 1909-10, Mech., Ill. Steel Co., So. Chicago, Ill. 1910-11, Draftsman, Ind. Steel Co., Ind. Harbor, Ind. 1911-12, Met., Amer. Steel Fdrs., Ind. Harbor, Ind. 1912, Met., Barris Spring Co., Kalamazoo, Mich. 1912-16, Elec. Furnace Engr., Gilmen & Halshe, N. Y. 1916-17, Supt., Stavanger Elec. Steel Wks., Stavanger, Norway. 1917-18, Chem., West Mich. Steel Fdry., Muskegon, Mich.

**William Spence Black, Cambridge, Mass.**

Present position: Resident Engr., Irish Creek Tin Mines, Montebello, Va.

Proposed by W. Spencer Hutchinson, Charles E. Locke, Allen H. Rogers.

Born 1891, Cambridge, Mass. 1909-13, Mass. Inst. of Tech., B. S. 1909, summer, Pipe-fitting Helper, Johnson Service Co., Boston, Mass. 1910, summer, Rodman & Transitman, Boston Elevated Ry. 1911, summer, Transitman & head of party, subway constr. wk. 1912, summer, Engr. & Office Man, B. F. Smith Constr. Co., Pawtucket, R. I. 1913-14, Laborer on mill constr., Assayer & Surveyor, Globe Cons. Min. Co., Dedrick, Calif. 1914-15, Miner, Draftsman, Sampler & Top Boss, Aurora Cons. Min. Co., Aurora, Nev. 1915-16, Supt. of Mobile mine, examination & reporting wk., The Mobile Co., Goodsprings, Nev. 1916-17, Supt. of Ajax mine, The Carolina Co., Victor, Colo. 1918, Assayer, Ely-Copperfield Assocs., W. Fairlee, Vt. 1918-19, U. S. Army.

**Gideon Boericke, Primos, Pa.**

Present position: Pres., Primos Chem. Co.

Proposed by Harold Boericke, Robert Sterling, Richard C. Morrison.

Born 1874, Philadelphia, Pa. 1893-97, Lafayette College, C. E. &amp; M. Sc. 1896-97, Erecting Engr. 1898-1901, Member of firm, Stein &amp; Boericke. 1901-18, Treas., Primos Chem. Co.

**L'Roche George Bousquet, Lowell, Mass.**

Present position: Chief Chem. &amp; Met., U. S. Cartridge Co.

Proposed by W. H. Bassett, F. G. Smith, D. R. Hull.

Born 1891, Indian Orchard, Mass. 1907-11, Tech. High School, Springfield, Mass. 1912-14, Mass. Inst. of Tech. 1915-16, Asst., Engrg. Dept.; 1916-17, Asst. Chem. &amp; Met., Metals Production Equipment Co., Springfield, Mass. 1917-19, Chief Chem. &amp; Met., New Jersey Tube Co., Harrison, N. J. 1919, Chief Chem. &amp; Met., Continuous Casting Corp., Garwood, N. J.

**Harold Edward Boyd, New York, N. Y.**

Present position: Oil Geol., Henry L. Doherty &amp; Co., N. Y.

Proposed by Ralph Arnold, H. Harper McKee, C. W. Washburne.

Born 1887, San Jose, Calif. 1907-12, Leland Stanford, Jr. Univ., A. B. 1912-15, Oil Geol., Caribbean Pet. Co., Venezuela, S. A. 1915-16, Engr., Co. Survey, Santa Clara Co., Calif. 1916-17, Oil Geol., J. Elmer Thomas, Tulsa, Okla. 1917-18, Oil Geol., J. R. Pemberton, Louisville, Ky. 1918, Oil Geol., Pomeroy &amp; Hamilton, Tulsa, Okla. &amp; U. S. Air Service in Calif.

**Jacob Britton, Forty Fort, Pa.**

Present position—1918 to date: Colliery Supt., Plymouth Colliery, Hudson Coal Co., Plymouth, Pa.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1870, Pottsville, Pa. Public School, Pottsville, Pa. 1889-1900, Min. Engr., Susquehanna Coal Co. 1900-01, Min. Engr., The H. C. Frick Coke Co. 1901-07, Dist. Engr., Lytle Coal Co. 1907-10, Dist. Engr., Susquehanna Coal Co. 1910-12, Supt., Oak Hill Coal Co. 1912-13, Supt., Schuylkill Lehigh Coal Co. 1913-15, Min. Engr., Susquehanna Coal Co. 1915-17, Asst. to Gen'l Supt., The Delaware &amp; Hudson Co. 1917-18, Asst. Div. Supt., The Hudson Coal Co.

**Samuel Scott Buckley, Syracuse, N. Y.**

Present position—1916 to date: Pres., Onondaga Steel Co., Inc.

Proposed by William H. Blauvelt, William L. Neill, John D. Pennock.

Born 1869, Kalamazoo, Mich. 1888-89, High School. 1900-02, Collaborated with two others in devel. of first high-speed steel in U. S. 1905-07, In charge of devel. of time of carbon tool steels, Halcomb Steel Co. 1907-10, Sales Mgr., Halcomb Steel Co. 1911-16, Charge of reorganizing &amp; sales, Tool Steel Dept., Bethlehem Steel Co.

**Wilfred Chauncey Cadwell, Anaconda, Mont.**

Present position—1911 to date: Supt. Surface Dept., Washoe Reduction Works, Anaconda, Mont.

Proposed by C. D. Demond, Louis V. Bender, Hugh J. Maguire.

Born 1881, Le Sueur, Minn. 1898-1905, Univ. of Minnesota, E. M. 1905-11, Civil Engr., Washoe Reduction Works, Anaconda, Mont.

**Herdman Fitzgerald Cleland, Williamstown, Mass.**

Present position—1901 to date: Prof. of Geol. &amp; Mineralogy, Williams College.

Proposed by James F. Kemp, H. Ries, Charles P. Berkey.

Born 1869, Milan, Ill. 1894-1900, Oberlin College, Yale College, B. A., Ph. D.

**Herbert Benjamin Coho, Mt. Vernon, N. Y.**

Present position: Business Director &amp; Engr.,

Proposed by William A. Cowan, Colin G. Fink, J. V. N. Dorr.

Born 1869, Ashland, Pa. 1885, Lane High School. 1886, Lane City College. 1886-90, Special course in eng. 1886-90, Lancaster County National Bank. 1890-92, Edison Gen'l Co., Schenectady, N. Y. 1892-95, Waddell Entz Elec. Co., Bridgeport, Conn. 1895-1902, Engr. &amp; Contractor, H. B. Coho &amp; Co., New York, N. Y. 1902-04, Vice Pres. &amp; Gen'l Mgr., Keystone Elec. Co., Erie, Pa. 1904-11, Sales Mgr., Burke Elec. Co., Erie. 1911-19, Charge of research, United Lead Co.

**Charles H. Constantine**, Carbondale, Pa.

Present position—1917 to date: Colliery Supt., Coal Brook Colliery, The Hudson Coal Co.

Proposed by R. Y. Williams, R. H. Buchanan, Charles Dorrance.

Born 1874, Scranton, Pa. 1880-90, Scranton P. S. 1894-95, Scranton Business College. 1900-03, Internat. Corres. School. 1888-1903, Practical colliery & mining experience. 1904-07, Outside Foreman Asst.; 1907-13, Outside Foreman; 1913-15, Div. Outside Foreman; 1915-16, Div. Supt.; 1916-17, Colliery Supt., Jermyn & Coal Brook.

**John William Cornelius**, Kingman, Ariz.

Present position: Unemployed.

Proposed by R. C. Jacobson, George F. Williston, T. D. Walsh.

Born 1882, Youngstown, Ohio. Public Schools of Ohio. 1904-12, Prospecting, min. & mill work. 1913, Mgr., American Metals Mines Co., Cedar, Ariz. 1914-15, Supt., Leviathan Mines Co., Kingman, Ariz. 1916, Laboratory, Mohave Assay & Engng. Co., Kingman, Ariz. 1916-18, Supt., Emerald Isle Copper Co., Kingman, Ariz. 1918-19, Sergt., Co. B, 27th Engrs., A. E. F.

**John Cabel Cromwell**, Cleveland, Ohio.

Present position: Pres., The J. C. Cromwell Steel Co., & Elyria Mach. Co., also Director in Alliance Mach. Co., Alliance Structural Co., & Cleveland Mach. & Mfg. Co.

Proposed by J. V. W. Reynders, James Gayley, Veryl Preston.

Born 1866, Frankfort, Ky. 1882-86, Univ. of Ill., B. S. & M. E. 5 yrs. as Chief Draftsman, Bates Mach. Co., Joliet, Ill. 5 yrs., Chief Engr., Joliet Wks., Ill. Steel Co. Since 1897, Partner & engr., Garrett-Cromwell Engrg. Co., Cleveland, Ohio.

**Launcelot A. Danse**, Detroit, Mich.

Present position: Met., Cadillac Motor Car Co.

Proposed by E. B. Horne, R. E. T. Haff, N. C. Banks.

Born 1889, Helena, Mont. 1913-16, Foreman, heat treating, Lyons Atlas Co. 1916-17, Foreman, heat treating, Delco. 1917-18, Heat-treat. Engr., Diamond Chain & Mfg. Co. 1918-19, Supt., heat treating, Lincoln Motor Co.

**Ernest P. Dargin**, Cincinnati, Ohio.

Present position: Gen'l Mgr., Holland-Amer. Mines Co., of Del., Mngng. Director Holland-Amer. Exploration Co.

Proposed by L. M. Banks, John J. Cadot, S. M. Walker.

Born 1870, Aubon, Maine. 1887-90, Colo. School of Mines, Golden. 1890-91, Draftsman for quartz mills, Capt. P. S. Scott, San Francisco, Calif. 1891-92, Head Draftsman, Harding & Jennings, Denver, Colo. 1892-96, U. S. Deputy Mineral Surveyor, Cripple Creek, Colo. 1896-97, Hydraulic placer min. wk., Rock Creek, Wyo. 1897-98, Mine examination, west coast of S. A. 1898-99, Supt., Helvetia mine, San Diego Co., Calif. 1899-1900, Eng., Quibridillas mine. 1900-01, Eng. Hidalgo Min. Co., Parral, Chih., Mex. 1901-02, Engr., Robt. W. Foderier, Phila., Dr. Dillon Brown, N. Y. 1902-07, Pres. & Gen'l Mgr., El Cambio Gold Min. Co. Topic, Mex. 1907-08, Engr., Pacific Italian Marble Co., Baja Cal., Mex. 1908-12, Office, Denver, Colo., Gen'l Engr. Wk. 1912-13, Mine examination wk., San Francisco, Calif. 1913-15, Gen'l Eng. Wk., Los Angeles, Calif. 1915-16, Unemployed. 1916-17, Mine examination wk., Dutch Guiana, S. A. 1917-19, Exploration wk., Dutch & British Guiana, S. A.

**William Davison**, Carbondale, Pa.

Present position: Colliery Supt., Powderly Colliery, The Hudson Coal Co., Mayfield, Pa.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1877, County of Durham, No. England. Public schools & night school. 1887-90, Slate Picker, Legitts Creek Colliery. 1890-91, Door Tender, Dixon Colliery. 1891-93, Driver, Marvine Colliery. 1893-95, Runner, Marvine Colliery. 1895-97, Motor Runner, Legitts Creek Colliery. 1897-1903, Engng. Corps, Scranton. 1903-14, Asst. Inside Foreman, Carbondale No. 1. 1914-16, Inside Foreman, Coal Brook. 1916-19, Colliery Supt., D. & H. Powderly, The Hudson Coal Co.

**Newton Randolph Denham**, Williamsburg, Ky.

Present position—1917 to date: Cons. Min. & Civ. Engr., Harlan, Ky.

Proposed by H. M. Yeager, W. Ward Duffield, Henry Groos.

Born 1885, Williamsburg, Ky. 1900-05, Cumberland Coll. 1905-08, Ky. State

Univ., B. E. M. 1909, Structural Draftsman & Tracer, Great Western Sugar Co., Ft. Collins, Colo. 1909-11, Map Draftsman & Computer, Union Pacific Coal Co., Rock Springs, Wyo. 1911-12, Draftsman & Computer on Appraisal, Omaha Gas Co., 1912-13, Civ. Engr. & Draftsman, Omaha Municipal Water Co., Omaha, Neb. 1913-14, Structural & Mech. Draftsman, Swift & Co., So. Omaha Plant. 1914, Report & Survey of Coal Operation, Four Mile, Ky. 1914-16, Min. Engr. & Surveyor, Johnston & Johnston, Engrs. 1916-17, Min. Engr., Wallins Creek Coal Co.

**Leslie Burton Duke**, Dayton, O.

Present position: Met. Research with Eng. Div., U. S. Air Service.

Proposed by W. M. Corse, L. W. Olson, W. H. Argue.

Born 1890, Peoria, Ill. 1905-08, Mech. Arts High School, Boston, Mass. 1908-12, Mass. Inst. Tech., Cambridge, Mass., B. S. 1912-14, Min. Engr., Vulture Mines Co., Wickenburg, Ariz. 1914-15, Asst. Co. Engr., Maui, T. H. 1915-16, Mgr., Ins. Dept., Wailuku National Bank, Maui, T. H. 1916-17, Asst. to New England representative, John B. Stetson Hat Co. 1917-19, 2d Lieut., U. S. Army.

**Irving W. Edwards**, Brooklyn, N. Y.

Present position—1918 to date: Asst. Leading Electrical Draftsman, N. Y. Edison Co., Eng. Dept. on Power Plant and Sub-station Design.

Proposed by R. S. Burdette, George A. Orrok, endorsed by American Electro-chemical Society.

Born 1886, Brooklyn, N. Y. 1905, Grad., Pratt Inst., Brooklyn. 1905-09, Engr. Asst., large engr. firms & public service corporations. 1909-18, Draftsman, specification writer & supervisor at electrical design for Cons. Engr. & Vice-Pres. of Edison Co. 1918-19, 1st Lt., Ord. Dept., U. S. A., inspection & design of plant, etc., in Alabama, & on mechanical design at fuses for artillery ammunition.

**Alma Ele**, Rancagua, Chile, S. A.

Present position: Chief Mech. Engr., Braden Copper Co., Chile.

Proposed by Lester E. Grant, M. S. Mazany, E. A. Cappelen Smith, Philip O. Harding.

Born 1880, Logan City, Utah. Univ. of Utah. 1903-06, Draftsman & Asst. Eng., Highland Boy Smelter, Murray, Utah. 1906-14, Designer & Smelt. Engr. in field. 1914-19, Master Mechanic & Chief Mech. Engr.

**Charles Tyndale Evans**, Titusville, Pa.

Present position—1918 to date: Chief Met., Cyclops Steel Co.

Proposed by Edwin Thomas, H. J. Seaman, Leonard Peckett.

Born 1872, Glen Moore, Pa. 1892-96, Dickinson College. 1899-1900, Univ. of Pennsylvania. 1900-01, Harvard Univ., B. A., M. A. 1896-1918, Teacher of Science, Centenary Coll. Ins., Hackettstown, N. J. & Dean, The Hill School, Pottstown, Pa.

**Francis Edward Evans**, Joplin, Mo.

Present position: Part Owner Ruhl & Stewart Engrg. Corp., Joplin, Mo.

Proposed by Otto Ruhl, C. H. Plumb, C. E. Hart.

Born 1891, Plainfield, Ill. 1911, Grad. Joplin H. S., Post Grad., Joplin Bus. Coll. 1919-15, Surgv. & Mill Constrn., Sanson & Funk Engrg. Co., & Ruhl & Shanklin Co., & Missouri Geol. Surv., Joplin, Mo. 1915-17, Gen'l min. wk., consg., & Mgr. Oklahoma Branch Office. 1917 to date, 110th U. S. Engineers, Fort Sill, preliminary & sewer wk., Graduated Engr. Officers Training Camp, made 2d Lieut., and then 1st Lieut. Engrs.; Supt. of Constrn. Base Hospitals at Mesves, France. Reported on Non-metals and Metals for Dept. of Economics, Peace Mission, Paris.

**Robert Moore Eyster**, Pittsburg, Okla.

Present position—1918 to date: Asst. Mgr., McAlester Edwards Coal Co., Okla.

Proposed by H. Denman, Walter Gilman, Franklin Bache.

Born 1890, Chambersburg, Pa. 1907-11, Lafayette College, E. M. 1908, summer, Transitman, County Survey of Pa. 1909-10, summers, Worked in mines New Jersey Zinc Co., Franklin Furnace, N. J. 1911-17, Eng. in charge, Pa. Min. Co. 1917-18, Supt., Fernwood Min. Co.

**Lewis Hooff Fawcett**, Alexandria, Va.

Present position—1918 to date: Asst. Chem. & Met., Navy Yard & Naval Gun Factory, Washington, D. C.

Proposed by P. E. McKinney, Jesse D. Jones, Guillian H. Clamer.

Born 1888, Alexandria, Va. 1907, Alexandria H. S. 1910-11, Carnegie Inst. Tech. 1907-09, Chem., Dunbar Furn. Co. 1909-11, Chem.; 1911-13, Factory Chem.; 1913-14, Chem.; 1914-17, Chief Chem., American Vanadium Co., Bridgeville, Pa. 1917-18, Chief Chem., High Speed Tools Corp., Toledo, Ohio.

**Edward Michael Flynn, Archbald, Pa.**

Present position—1916 to date: Colliery Supt., Grairty Slope Colliery, The Hudson Coal Co.

Proposed by R. H. Buchanan, R. Y. Williams, C. Dorrance.

Born 1883, Plymouth, Pa. 1889–1900, Public School of Plymouth. 1900–02, Note man, on surveying corps. 1902–09, Fire Boss; 1909–13, Asst. Inside Foreman; 1913–14, Mine Foreman; 1914–16, Asst. Div. Supt., Del. & Hudson Coal Co.

**Edward M. Freeland, Sparrows Point, Md.**

Present position: Asst. to Engr. of Test. in charge of met. research, Bethlehem Steel Co.

Proposed by W. F. Roberts, R. J. Wysor, Edwin Barnhart.

Born 1886, Burton, W. Va. 1903–07, Western Univ. of Pa., B. Sc. 1907–09, Asst. Chem., Carrie Furnaces, Carnegie Steel Co. 1909–10, Chem., Wheeling Corrugating Co., Wheeling, W. Va. 1910–12, Asst. Chem.; 1912–15, Chief. Chem.; 1915–18, Chem. & Efficiency Engr., Whitaker-Glessner Co., Ohio.

**Truman S. Fuller, Schenectady, N. Y.**

Present position—1911 to date: Met., Research Lab., Gen'l Elec. Co.

Proposed by W. E. Ruder, W. R. Whitney, C. V. Ferguson.

Born 1888, Saratoga Springs, N. Y. 1907–11, Syracuse Univ., B. S.

**Louis Duncan Tallman Geery, Chuquicamata, Chile, S. A.**

Present position: Asst. Supt., Electrolytic Tank House.

Proposed by E. L. Jorgensen, C. S. Whitherell, H. C. Bellingren.

Born 1888, Fanwood, N. J. 1907, Worcester Academy. 1911, Univ. of Maine, B. S. 1911, summer, Shiftman in plating dept., Tube Bending & Machine Polishing Co. 1912, Chem., Grasselli Chem Co., Clarksburg, W. Va. 1912–15, Shiftman, experiment plant, Chile Expl. Co., Maurer, N. J. 1915 to date, Shiftman in elec. tank house, Chile Expl. Co.

**Harry Goodnow, Du Quoin, Ill.**

Present position: Chief Engr., Equitable, Searls & Duncan Coal Co.'s.

Proposed by C. M. Young, E. A. Holbrook, H. H. Stoek.

Born 1888, Red Wing, Minn. 1907–08, Univ. of Minn. 1907, Chairman, Chicago, Milw. & St. Paul R. R. 1908–09, Rodman (same company). 1909, Transitman, The "Soo" Line. 1909, Topographer, Great Northern R. R. 1909–14, Camp Mgr., Winston Bros. Co., R. R. Constr. 1914, Instrumentman, Chicago Northwestern, Constr. 1915–19, Chief Engr., Equitable Coal & Coke Co., Ill. & Chief Engr., Searls Coal Co., Johnston City, Ill. 1917–19, Chief Engr., Duncan Coal Co., Herrin, Ill.

**Walter Franklin Graham, S. Plainfield, N. J.**

Present position: Met. in charge of heat treatment, Spicer Mfg. Corpn.

Proposed by W. P. Barba, E. S. Moore, George J. Salmon.

Born 1891, Philadelphia, Pa. 1901–08, Haverford School. 1908–09, Haverford College. 1910–14, Pa. State College, B. S. 1909–10, Asst., Met. Dept.; 1912–13, summers, Standard Roller Bearing Co., Philadelphia, Pa. 1914–16, Gen'l met. & production wk., Ferro Mach. & Fdry. Co., Cleveland, Ohio. 1916–18, Met., in charge of heat treatment, Ingersoll Rand Co., Athens, Pa. 1918–19, Lieut., Ord. Dept., Washington, D. C.

**William Turner Grey, Holguin, Cuba.**

Present position—1913 to date: Supt., Holguin Expl. Co.

Proposed by F. M. Simonds, E. Renshaw Bush, Harold P. Banks.

Born 1878, Reigate, England. 1902, Bucknell Univ. (Science). 1903, Asst. Mgr., International Kaolin Co., Belair, Md. 1903–04, Mgr., Tuscarora Lumber Co., Kilmer, Pa. 1904–10, Mgr., Holguin-Santiago Min. Co., Holguin, Cuba. 1910–12, Prospecting, Santo Domingo & Puerto Rico. 1912–13, Mgr., Ayesha Min. Co., Holguin, Cuba.

**Harry Adam Grine, Langeloth, Pa.**

Present position—1912 to date: Gen'l Supt., American Zinc & Chem. Co.

Proposed by H. L. Brown, M. W. Hayward, D. F. Haley, Max Schott.

Born 1878, St. Louis, Mo. 1885–1900, St. Louis grade & high schools. 1900–02, Washington Univ., St. Louis, Mo. 1902–04, Mo. School of Mines, B. S. 1904, summer, Timekeeper, Laclede Gas Co., St. Louis, Mo. 1904–08, Gas Analyst, charge

of shift on gas-producer tests, U. S. Fuel Testing Dept. 1908-09, Devel. of crude oil producer gas generator, Western Gas Engine Co., Los Angeles, Calif. 1909-11, Private devel. of crude oil, gas generator & oil burning appliances. 1911-12, Gas Power Machinery Co.

**Clarence A. Hall**, Philadelphia, Pa.

Present position: Chem. Engr., Lake Superior Corpn.

Proposed by H. N. Spicer, J. V. N. Dorr, R. C. Canby.

Born 1874, Philadelphia, Pa. 1896, Univ. of Pa., Towne Scientific School, B. S. Ch. Chem. & later Supt., Carbide Wks., Sault St. Marie; Chief Chem., Lake Superior Corpn. Have been with the Pa. Salt Mfg. Co. for many years.

**Frederick Julian Harlow**, Kansas City, Mo.

Present position—1915 to date: Cons. Engr., Natl. Zinc Co.

Proposed by Otto Rissmann, Walter Renton Ingalls, Eugene P. McCorken.

Born 1888, Chicago, Ill. 1893-1906, Ward & Manual Training High School, Mo. 1911-13, Special student, Engrg. Univ. of Mo. 1906-07, Rodman, U. P. R. R. Engrg. Dept., Kansas Div., Kansas City, Mo. 1907-08, Asst. City Engr., Miami, Okla. 1908-09, Asst. Engr., O. K. & M. R. R., Miami to Commerce, Okla. 1909-11, Transitman & Asst. Engr., Tuttle & Pike, Civil Engrs., Kansas City, Mo. Cons. & gen'l engrg. practice. 1913-14, Chief Draftsman, George T. Sasse, Arch., Columbia, Mo. 1914-15, Draftsman, Chief Engrs. Office of Board of Education, Kansas City, Mo.

**Harold Boyning Hewlett**, Melton, Mowbray, England.

Present position: Asst. Mines Mgr., Stanton Iron Wks. Co., Ltd.

Proposed by Herbert K. Scott, Henry Louis, R. E. Palmer.

Born 1884, Manchester, England. 1895-1901, Woodlands School, Fallowfield, Manchester. 1901-05, Manchester Univ., B. Sc. 1905-08, Asst. to Chief Engr., Lancashire & Yorkshire R. R. 1908-12, Engrs. Asst. to Resident Engr., L. Y. R. & L. N. W. R., Fleetwood, on permanent way const. & maintenance & dock & harbor wk. 1912-18, Mines Engr. & Geol., Holwell Iron Co., Ltd., Melton, Mowbray, England. 1918 to date, Asst. to Mines Mgr., Engr. & Geol., Holwell Iron Co., Ltd.

**James Morris Hicks**, Scranton, Pa.

Present position: Colliery Supt., Langeliffe Colliery, The Hudson Coal Co., Avoca, Pa.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1877, Evington, Va. 1883-96, New London Academy, Forest Depot, Va. 1897-1902, Va. Poly. Inst., Blacksburg, Va., B. S. & M. E. 1902-03, Chainman & Transitman, Pocahontas Coal & Coke Co., Bramwell, W. Va. 1903-08, Transitman, Draftsman & Cons. Engr., A. R. Paddock, N. Fork, W. Va. 1908-10, Min. Engr., Red Jacket Cons. Coal & Coke Co., Red Jacket, W. Va. 1910-14, Mine Supt., Madeira Hill & Co., Wilsonburg, W. Va. 1914-15, Const. Engr., Madeira Hill & Co., Pottsville, Pa. 1915-16, valuation, Lehigh Valley Coal Co., Wilkes-Barre, A. B. Cochran & Son, Engrs., Pottsville, Pa. 1916-19, Asst. Div. Engr., Div. Engr. & Colliery Supt., The Hudson Coal Co.

**William H. Hill**, Chicago, Ill.

Present position: Dist. Sales Mgr., Harbison Walker Refractories Co.

Proposed by C. W. Gennet, Jr., Luther V. Rice, J. Hayes Campbell.

Born 1874, Pennsylvania. 1899, Muskegan College. 1903-19, Harbison Walker Refractories Co.

**Harry Gilbert Houtz**, Welch, W. Va.

Present position: Div. Engr., Solvay Collieries Co.

Proposed by H. W. Saunders, Arthur Bartlett, L. A. Osborn.

Born 1887, Frackville, Pa. 1903, High School of Pa. 1912, Internat. Corres. Schools. 1912-15, Chainman, Transitman, & Draftsman, Lehigh Coal & Navigation Co., Lansford, Pa. 1915-16, Transitman & Draftsman, Harwood Coal Co., Harwood, Pa. 1916, Draftsman, Del. & Hudson Coal Co., Scranton, Pa. 1916-17, Member of engrg. firm of Baldwin & Houtz, Pikeville, Ky. 1917-18, In charge of field wk., Semet Solvay Co., Ashland, Ky. 1918-19, Div. Engr., in charge of Welch Office, Solvay Collieries Co.

**Waller Chenault Hudson**, Guayaquil, Ecuador, S. A.

Present position—1918 to date: Exploration Engr., S. A. D. Co., Guayaquil, Ecuador.

Proposed by A. M. Tweedy, L. O. Kellogg, William A. Wolf.

Born 1884, Lancaster, Ky. 1905, Centre College of Ky. 1906, Princeton. 1913, Colo. School of Mines, A. B., A. M., E. M. 1907, summer, Miner, Granite-Bimetallic Mine, Granite, Mont. 1912, summer, Colo. Geol. Survey, Saguache Co., Colo. 1913, summer, Engrg. Dept., Ray Cons. Copper Min. Co., Ray, Ariz. 3 mos. Topman, North Star Min. & Devel. Co., Tonopah, Nev. 1914-15, Engrg. Dept., Braden Copper Co., Rancagua, Chile. 1915-17, Engr., S. A. D. Co., Portovelo, Ecuador. 1917-18, Asst. Supt., Aztec gold mine, Baldy, N. M.

**Sun Hyien-way**, Changsha, Hunan, China.

Present position: Min. Engr., Bureau of Industries, China.

Proposed by Y. F. Chen, S. Ken Huang, William A. Wong.

Born 1886, Hangchow, Chekiang, China. 1892-99, C. M. S. Schools. 1899-1906, St. John's College, Shanghai, China. 1909-13, Columbia Univ., New York, N. Y., E. M. 1906-09, Instructor of English, Chekwang High School, Chekiang. 1914-15, Dean, Huan Poly. Inst., Huan, China. 1915-16, Dean, Wayland Academy, Chekiang. 1916-19, Min. Engr., Dept. of Mine Administration, Bureau of Finance.

**Donald Forsha Irvin**, Antofagasta, Chile, S. A.

Present position—1917 to date: Constr. & Sales Engr., Oliver Continuous Filter Co., San Francisco, Calif.

Proposed by E. E. Barker, Huntington Adams, Harry A. Harper.

Born 1879, Glenwood, Mo. Univ. of Calif., B. S. 1906-07, worked on Construction of slime-filter plant, Homestake Min. Co., Deadwood, S. D. 1907, Draftsman, W. A. Hendryx, Denver, Colo. 1908-09, Mine leasing in Goldfield Dist., Nev. 1909-10, Stampmill & cyanide plant wk., Goldfield Cons., Goldfield & Mont.-Tonopah, Tonopah, Nev. 1910, Shift Boss, cyanide plant, Standard Cons. Min. Co., Bodie, Calif. 1910-11, Cons. wk. & acting Mill Supt., Vulture Mines Co., Wickenburg, Ariz. 1911-14, Charge cyanide plant, Aguacate Mines Co., San Mateo, Costa Rica, C. A. 1916, Production "heavy-chemicals," Los Angeles, Calif.

**Willard Rouse Jillson**, Frankfort, Ky.

Present position: State Geol. of Kentucky.

Proposed by Stuart St. Clair, C. L. Severy, J. R. Pemberton.

Born 1890, Syracuse, N. Y. 1908-12, Syracuse Univ. 1914-15, Univ. of Wash. 1915-16, Univ. of Chicago. 1916-17, Yale Univ., B. S. 1914-15, Instructor in Geol. 1915, Topographer, U. S. G. S., Mt. St. Helens Quad. 1916, Field Geol., with party, Carter Oil Co., Osage, Okla. 1917-18, Cons. Geol. in Okla., Kans., Texas, Ala., W. Va., Tenn., Ky., etc. 1918-19, Asst. Prof. Geol.

**Verne D. Johnston**, Montreal, Wis.

Present position—1918 to date: Min. Engr. & Geol., E. W. Hopkins, Range Mgr., Oglebay, Norton & Co., Ironwood, Mich.

Proposed by W. O. Hotchkiss, E. W. Hopkins, John M. Price.

Born 1889, Sully Co., S. D. 1906-09, Grove City College, Grove City, Pa. 1910-13, Mich. College of Mines, Houghton, Mich., E. M. 1910 & 1913, summers, Min. & Civil Engr., L. E. Burnside & Co. 1913-16, Asst. Engr.; 1916-18, Min. Engr., Montreal Min. Co., Hurley, Wis.

**Abner C. Jones**, Chicago, Ill.

Present position: Chief Chem. & Met., Electric Steel Co., Chicago, Ill.

Proposed by Harold C. Brown, LaVerne W. Spring, Leslie E. Howard.

Born 1891, Chicago, Ill. 1904-08, Crane Tech. H. S. 1908-10, Armour Inst. of Tech. 1910-16, Asst. to Chief Met., Crane Co. 1916-18, Chem. & Met., Otis Elevator Co., Buffalo Wks. Cupola & Electric Steel Furnace. 1918, Senior Insp. of Materials & Test., Thomas-Morse Aircraft Corp., Bureau of Aircraft Production, Buffalo Dist., Ithaca, N. Y. 1918-19, 2d Lieut., U. S. Army.

**Edward LeRoy Jones, Jr.**, Cheyenne, Wyo.

Present position: Geol., Roxana Petroleum Co.

Proposed by Henry G. Ferguson, J. F. Kemp, David White.

Born 1886, Alamosa, Colo. 1904-09, Univ. of Utah. 1909-10, Columbia Univ., B. S., A. M. 1910-19, Junior Geol., Asst. Geol. & Associate Geol., U. S. Geol. Survey.

**John Benjamin Todd Jones**, Wilkes Barre, Pa.

Present position: Colliery Supt., Laftin Colliery, The Hudson Coal Co., Laftin, Pa.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1880, Wales. 1898-1902, Scranton High School; Intern. Corres. School. 1901-08, Engr. Corps, Transitman & Asst. Div. Engr.; 1908-10, Acting Div. Engr.; 1910-16, Div. Engr., Min. Dept.; 1916-19, Colliery Supt., Laftin Colliery, Hudson Coal Co.

**William Stephen Webster Kew**, Berkeley, Calif.

Present position—1918 to date: Assoc. Geol., U. S. Geol. Survey.

Proposed by Andrew C. Lawson, George D. Louderback, Ernest A. Hersam.

Born 1890, San Diego, Calif. 1905-09, San Diego H. S. 1909-17, Univ. of Calif., Ph. D. 1915-16, Geologic Aid, U. S. Geol. Survey. 1917-18, Asst. Geol., U. S. G. S.

**Frank Herman Kingdon**, Claremont, N. H.

Present position—1913 to date: Met., Iron & Steel, Sullivan Mach. Co.

Proposed by Leslie D. Hawkrige, Albert Sauveur, Herbert M. Boylston.

Born 1886, Syracuse, N. Y. 1899-1903, Syracuse Schools. 1905-08, Lehigh Univ. 1908-12, Chem., in Steel Lab., Crucible Steel Co., Sanderson Wks., Syracuse, N. Y. 1912-13, Chief Chem. & Asst. Met., Russell Motor Car Co., Toronto, Canada.

**Frederick Benjamin Kollberg**, Patagonia, Ariz.

Present position—1917 to date: Gen'l Mgr., Flex Min. Co.

Proposed by Josiah Bond, Alvin B. Carpenter, Maurice Clark.

Born 1880, Gottenborg, Sweden. 1904-10, In charge constr. work, Montezuma Copper Co., Nacozari, Sonora, Mex. 1910-14, Independent mine operator, Nacozari, Sonora, Mex. 1914-17, Charge of constr. & operations experimental mill, Copper Queen Branch Phelps-Dodge Corp., Bisbee, Ariz. 1917-19, Organized the Flex Min. Co.

**Edward H. Kraus**, Ann Arbor, Mich.

Present position: Prof. of Mineralogy, Crystallography, & Director of Mineralogical Lab., Univ. Mich.

Proposed by H. Ries, Alfred C. Lane, Frank R. Van Horn.

Born 1875, Syracuse, N. Y. 1892-97, Syracuse Univ., B. S. & M. S. 1899-1901, Univ. Munich, Ph. D. 1901-02, Assoc. Prof., Mineralogy, Syracuse Univ., Syracuse, N. Y. 1904-06, Assoc. Prof., Univ. of Mich., Ann Arbor, Mich. 1908-09, Prof., Mineralogical Lab., Univ. Mich.

**Karl Martin Kroz**, Chuquicamata, Chile, S. A.

Present position: Supt., Electrolytic Tank House, Chile Expl. Co.

Proposed by H. C. Bellingren, C. S. Witherell, E. L. Jorgensen.

Born 1889, Roros, Norway. 1908-09, Trondhjuis Teknishe Lareauhalt, Chem. Eng. 1907-08, summers, Apprentice, Roros Kobbervark, Roros, Norway. 1909-10, Asst. in Chem. Dept., Norges Landbrubshoiskole. 1910-13, Asst. in Chem. & Tech. Dept., Trondhjems Teknishe Lareauhalt. 1913-14, Apprentice in smelter, American Smelt. & Refin. Co., Maurer, N. J. 1914, Research Chem., Maurer, N. J. 1914-15, Research Chem., Baltimore, Smelt. & Rolling Copper Co., Md. 1915-18, Shift foreman, Electrolytic Tank House, Chuquicamata, Chile. 1918-19, Asst. Supt., Elec. Tank House.

**Carl Eugene Leshner**, Washington, D. C.

Present position: Geol. in charge of Mineral Fuel Statistics.

Proposed by Sidney Paige, David White, E. F. Burchard.

Born 1885, La Junta, Colo. 1908, Colo. School of Mines, E' Met. 1908-10, Chem., Canada Zinc Co., Nelson, B. C. 1908, 6 mos., & 1909, Kootenay Belle gold mine & assoc. companies, with Dr. Frank Morrison of Nelson, B. C. 1909, Chem., Whitewater mines, Kasto, B. C. 1910, Chem. & Engr., Amer. Nitrogen Co., Joliet, Ill., & Draftsman, Koffers Co., Joliet. 2 mos. Engr., with Michael Hayman & Co., Buffalo, N. Y. 1910 to date, U. S. Geol. Survey, Washington, D. C.

**Benjamin Plummer Little**, Copper Mountain, B. C.

Present position: Acting Supt., Mines, Canada Copper Corp., Ltd.

Proposed by Allen H. Rogers, H. R. Van Wagenen, Van H. Smith.

Born 1868, Ridgway, Pa. Ridgway High School. 1887-90, Asst. Engr., Cripple Creek Branch, Norfolk & Western R. R. & worked for Chambers & McKee Glass Co., Jeanette, Pa. & Charleroi Plate Glass Co., Charleroi, Pa. 1890-93, Engr. of Const., Westinghouse Air Brake Co. 1893-95, Ship wk. & erecting, Carnegie Steel & Am. Bridge Co. 1895-97, Mine wk., assaying & milling, Colo., Blackhawk, Telluride

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS IV

**Dista.** 1897-1900, Mgr., Escondido Gold Min. Co., Calif. 1900-02, Const. Engr., Enterprise, B. C.; Payne Cons., Sandon, B. C. 1902-04, Gen'l Foreman, Payne mine and mill, Sandon, B. C. 1904-06, Lessee, Payne mine & mill & private practice 1906-10, Engr. & Asst. Mgr., Diamond Vale Collieries. 1910-14, Mgr., B. P. Little Const. Co., Kelowna, B. C. 1914-16, Flotation wk., Coeur d'Alene, Idaho. 1917-18, Const. & Mine Boss, Orogrande G. M. Co., Idaho. 1918-19, Supt. of Cons. Canada Copper Corpn.

**William Richard Longmire**, Duncan, Okla.

Present position: Resident Geol., Marland Refin. Co., Southwest Okla.

Proposed by Everett Carpenter, Alexander W. McCoy, C. F. Tolman, Jr.

Born 1889, Clinton, Tenn. 1910-12, Pomona College. 1912-16, Stanford Univ. A. B. 1913, Miner, South Eureka Min. Co., Sutter Creek, Calif. 1914-16, Field Geol., Southern Pacific Co. & Kern Trading & Oil Co. 1916, Field Engr., Indiana Gold Dredging Co. 1916-19, Field & Office Geol., Empire Gas & Fuel Co.

**Jerome McCrystle**, Wilkes Barre, Pa.

Present position: Asst. Div. Supt., The Hudson Coal Co., Wilkes Barre, Div.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1886, Minersville, Pa. 1892-1903, Minersville High School. 1903-10, Chainman & Transitman, Phila. & Reading Coal & Iron Co., Pottsville, Pa. 1911-12, Div. Engr., Consolidation Coal Co., Jenkins, Ky. 1912-16, Dist. Engr., Lehigh Coal and Navigation Co., Lansford, Pa. 1916, Underground, rock contracting. 1916-19, Special Engr., Div. Engr., Asst. Div. Supt., Hudson Coal Co., Scranton, Pa.

**Edward F. McGlynn**, Scranton, Pa.

Present position—1916 to date: Colliery Supt., Marvine Colliery, The Hudson Coal Co.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1861, Carbondale, Pa. Common school education. 1869-71, Slate picker, Olyphant, Pa. 1871-76, Mule driver, Olyphant, Pa. 1876-77, Miner's laborer, Scranton, Pa. 1877-80, Miner, foreman, Olyphant, Pa. 1880-91, Foreman, Driver boss, Olyphant, Pa. 1891-1900, Foreman Asst. & Foreman, Scranton, Pa. 1900-16, Foreman, Scranton Mine, Del. & Hudson Co.

**James J. McKitterick**, Pittsburgh, Pa.

Present position: Asst. Coal Min. Engr., Pittsburgh Experiment Sta., U. S. Bureau of Mines.

Proposed by E. A. Holbrook, J. W. Paul, Dorsey A. Lyon.

Born 1892, Jackson, Ohio. 1906-10, Jackson H. S. 1912-16, Ohio State Univ. Certificate, M. E. 1916-17, Asst. Coal Min. Engr., Robert Gage Coal Co., Bay City, Mich. 1917-18, Gen'l Supt., Pomeroy Colliery Co., Pomeroy, Ohio. 1918, Junior Chem., Research Div., Chemical Warfare Service, Washington, D. C., & Pittsburgh, Pa.

**Andrew Cyrus McLaughlin**, San Francisco, Calif.

Present position: Vice-pres. & Gen'l Mgr., Assoc. Oil Co.

Proposed by Arthur F. L. Bell, M. E. Lombardi, E. G. Gaylord.

Born 1875, Austin, Tex. 1892-96, Univ. of Texas. 1896-99, Johns Hopkins Univ., B. S., Geol. Survey, in Texas, Md. & Mo.; Geol., Houston Oil Co., Tex., Supt. & Mgr., Refinery Dept.; Asst. to Pres. Southwestern Oil Co., Supt. of Operations, Fuel Dept., Southern Pacific Co.

**Benjamin Arthur McNelly**, Warren, Ariz.

Present position—1917 to date: Asst. Chief Chem., Calumet & Ariz. Min. Co.

Proposed by Ira B. Joralemon, Robert H. Dickson, D. M. Rait.

Born 1886, Globe, Ariz. 1894-99, Grammar School. 1899-1900, Los Angeles, Mil. Acad. 1901-05, Univ. of Ariz. 1902-04, Helper in lab. 1905-06, Asst. Chem., Old Dominion Copper Co., Globe, Ariz. 1907-10, Ranching in Calif. 1910-11, Asst. Chem., Calumet & Ariz. Min. Co., Warren & Douglas, Ariz. 1912-17, Asst. Chem., Calumet & Ariz. Min. Co.

**William Everett Malm**, Cleveland, Ohio.

Present position: Asst. Mgr., The Cleveland Arcade Co., Treas., Cleveland Bldg. Owner's & Mgr's Assoc.

Proposed by Harry Wolf, D. E. A. Charlton, E. P. McCrorken.

Born 1886, Titusville, Pa. 1911-12, Short time at La. State Univ., East High School, Cleveland, Ohio. 1906-08, Foreman, United Zinc Co., Corbin, Mont. 1908-10, Supt., Georgetown Plant, met. wk. & const., Western Metals Co., Denver, Colo.

1910-11, Surveying, boiler testing, geol. efficiency work, Elkton Gold Min. Co., Elkton, Colo. 1911-12, Investigation sugar industry, La. Oriente Sugar Co. 1913-14, Met. wk., Midwest Metals Co., Denver, Colo. 1914-15, Assaying & chem. wk., Federal Min. & Smelt. Co., Wallace, Ida. 1915-17, Gen'l Mgr. & Cons. Engr., Walla Walla Copper Mining Co. 1915-17, Gen'l Mgr. & Cons. Engr., Northwest Mines Devel. Co., Spokane, Wash. 1917-19, Member, Malm-Wolf Co., Min. & Met. Engrs., Denver, Colo.

**George Rogers Mansfield**, Washington, D. C.

Present position—1913 to date: Geologist, U. S. Geol. Surv., Washington, D. C.

Proposed by David White, F. L. Ransome, C. E. Siebenthal.

Born 1875, Gloucester, Mass. 1893-94, Massachusetts Agri. Coll. 1894-97, Amherst Coll., B. S. 1902-03, Case Sch. of Applied Sci. 1903-06, Harvard Univ., Ph. D. 1897-1903, Teacher Physics & Phys. Geog., Cent'l. H. S., Cleveland, O. 1904-09, Austin Teaching Fellow & Instrctr. in Geol., Harvard Univ. 1909-13, Asst. Prof. Geol., Northwestern Univ. 1910-13, Asst. & Associate Geol., U. S. Geol. Surv., Washington, D. C.

**Charles Edwin Margerum**, Charleston, W. Va.

Present position—1918 to date: Met., U. S. Naval Ord. Plant.

Proposed by William J. Priestley, William M. Corse, P. E. McKinney.

Born 1881, Middletown, Ohio. High School. 1894-99, Middletown High School. 1902-03, Asst. Chem., Amer. Rolling Mill Co., Middletown, Ohio. 1903-09, Chief Chem., N. & G. Taylor Co., Cumberland, Md. 1910-13, Chem., Gen'l Elec. Co., W. Lynn, Mass. 1913, Chem., Gen'l Elec., Schenectady, N. Y. 1913-15, Asst. Supt., Open-hearth Dept., Md. Steel Co., Sparrows Point, Md. 1915-16, Chem. & Met., Amer. Steel Fdrs. Co., Indiana Harbor, Ind. 1916-17, Chem., Titanium Alloys Mfg. Co., Niagara Falls, N. Y. 1917-18, Asst. Chem. & Met., U. S. Navy Yard, Washington, D. C.

**Andrew Jackson May, Jr.**, Salt Lake City, Utah.

Present position: Cons. Min. Engr.,

Proposed by Paul Hilsdale, Edward R. Zalinski, J. H. McChrystal.

Born 1887, Tazewell, Va. 1902-04, Pantops Academy. 1904-05, Fishburn Military School. 1905-08, Episcopal High School. 1908-12, Colo. School of Mines, E. M. 1912-14, Practical min. experience, Colo., Nev., Ariz. 1914-15, Assayer, Cananea Con. Copper Co., Cananea, Sonora, Mexico. 1915-16, Assayer, New Reliance Gold Min. Co., Trojan, S. D. 1916-17, Supt., Oro Ext. M. & M. Co., Breckenridge, Colo. 1917-18, Mgr., Puzzle-Ouray Mine, Breckenridge, Colo. 1918-19, Master Engr., 27th Engrs., U. S. A.

**Millard Warren Merrill**, Elizabeth, N. J.

Present position: Asst. Supt. of Electrolytic Copper Refinery, Chrome, N. J.

Proposed by Ralph W. Deacon, Sidney Rolle, Francis R. Pyne.

Born 1892, Amesbury, Mass. 1908-13, Mass. Inst. of Tech., S. B. 1913-14, Asst. in charge elec. chem. lab., Mass. Inst. of Tech. 1914, Research Engr., experimental lab., Chile Exploration Co. 1914-15, Research Engr., experimental leaching plant, Braden copper mines, Chile, S. A. 1915-18, Shift Foreman, Night Supt., Asst. Supt., Chile Copper Co., Chuquicamata, Chile. 1918-19, Research Engr., Chile Exploration Co., N. Y. 1918, U. S. Army.

**John Wesley Merritt**, Ft. Worth, Tex.

Present position—1918 to date: Chief Geol., Sapulpa Refrg. Co., Sapulpa, Okla.

Proposed by Dorsey Hager, A. Edmond Robitaille, M. L. Fuller.

Born 1885, Atchison County, Mo. 1906-12, Northwestern Univ., B. S., M. S. 1916-17, Wisconsin Univ., Ph. D. 1913-14, Geol. Aid, U. S. G. S., Idaho, Utah & Wyoming. 1911-12, Teaching Fellow, Geol., Northwestern Univ. 1912-16, Instrctr. Geol., Dartmouth Coll. 1916, Geol., Charge Field Party, Roxana Petroleum Co. 1916-17, Fellow in Geol., Wisconsin Univ. 1917-18, Geol., Field Party, Roxana Petroleum Co., Chg. S. Oklahoma Div.

**Mark Benton Mitchell**, Weeksbury, Ky.

Present position: Gen'l Supt., Elkhorn Piney Coal Min. Co.

Proposed by R. E. Rightmire, John G. Smyth, George S. Watson.

Born 1883, Fairmont, W. Va. 1904-10, Transitman, Asst. Engr., Air Inspector, Mine Foreman, Consolidation Coal Co., Fairmont, W. Va. 1910-13, Gen'l Mine Inspector, Mine Foreman, Utah Fuel Co., Salt Lake City, Utah. 1913-17, Supt., Mines & Div. Mgr., Elkhorn Coal Corp., Fleming, Ky.

**Willis Perry Mould**, Mineville, N. Y.

Present position: Engr., Witherbee, Sherman & Co.

Proposed by E. S. Dickinson, Frank L. Nason, S. H. Witherbee.

Born 1892, Keeseville, N. Y. 1911-12, Univ. of Vermont. 1913, Colorado School of Mines. 1913-19, Miner, Shift Boss, Surveyor & Engr., Witherbee, Sherman & Co., Mineville, N. Y.

**Homer Chidsey Neal**, Southington, Conn.

Present position: Unemployed.

Proposed by S. J. Gormly, D. C. Martin, R. K. Stockwell.

Born 1887, Southington, Conn. 1904-12, Yale Univ., B. A., Ph. B., E. M. 1910-11, Miner & Millman, Bunker Hill & Sullivan Min. & Concentrating Co., Kellogg, Id. 1912-16, Sampler, Surveyor, Shift Boss, Foreman, Braden Copper Co., Rancagua, Chile. 1916, Mine examination wk., Central Chile Copper Co., Panulcillo, Chile. 1917-18, Mine examination wk., M. Hochschild, Coquimbo, Chile. 1918, Bureau of Aircraft Production, investigation of plants. 1918-19, U. S. Army Lieut.

**Harry Benedict Northrup**, State College, Pa.

Present position: Assoc. Prof. & Acting Head Dept. of Met., Pennsylvania State College.

Proposed by William R. Chedsey, E. S. Moore, C. E. McQuigg.

Born 1886, Akron, O. 1901, Common school, Akron, O. 1905, Akron H. S. 1909-11, Ohio State Univ., E. M. 1907-08, Gen'l mine labor, Mikado Mine, Verona, Mich. 1915, summer, Met. laboratory, U. S. Steel Corp., Gary, Ind. 1916, summer, Asst. O. H. Pit Foreman, Cambria Steel Co. 1918-19, Met. Engr., Div. Ordnance Dept., Bridgeport Dist. Ord. Office. 1911-19, Dept. of Met., Pennsylvania State College.

**Harry Jackson Myles**, Mount Morgan, Queensland, Australia.

Present position: Asst. Mine Mgr., Mount Morgan mine.

Proposed by A. A. Boyd, James Horsburgh, B. G. Patterson.

Born 1888, Tewantin, Queensland, Australia. 1910-12, Ballarat School of Mines. 1912, Mine Surveyor, Johnsons Reef mine. 1913-14, Asst. Insp. of mines, Charters Towers. 1914-16, Australian Imperial Forces. 1916-17, Insp. of Mines, Queensland Government Mines Dept. Seven years practical mining experience on various fields in Queensland and Victoria.

**Edgar Daniel Newkirk**, Syracuse, N. Y.

Present position—1913 to date: Engr. & Treas., Onondaga Steel Co., Inc.

Proposed by William H. Blauvelt, William L. Neill, John D. Penneck.

Born 1875, Verona, N. Y. 1898, Canastota. 1898-1902, Cornell Univ. 1902-04, Engr., Westinghouse Mach. Co., Pittsburgh, Pa. 1905-07, Supt., Rome Wire Co., Rome, N. Y. 1908-09, Engr., Cobalt Central mines, Cobalt, Ont., Canada. 1909-13, Engr., & Sec'y Mgr., Marvin & Casler Co., Canastota, N. Y.

**Walter Frederick Nickle**, Butte, Mont.

Present position—1915 to date: Engr., Anaconda Copper Min. Co.

Proposed by F. A. Linforth, E. B. Young, M. H. Gidel.

Born 1889, Butte, Mont. 1895-1909, Grades, High School of Butte, Mont. 1909-13, Univ. of Wis., B. S., C. E. 1913, Engr., City of Chippewa Falls, Wis. 1913-14, Sampler, Berkeley mine, Butte, Mont.; Anaconda Copper Min. Co., Butte, Mont. 1914, Engr., City of Butte. 1915, Engr. on electrification of Chicago, Mil. & Puget Sound R. R. & Asst. & Chief Engr. of electrification.

**Seiji Noda**, Tokio, Japan.

Present position—1917 to date: Chief Min. Geol., Kuhara Min. Co.

Proposed by George S. Nishihara, Tsunashiro Wada, K. Takenouchi.

Born 1882, Tokio, Japan. 1903-06, Imperial Univ. of Tokio. 1906-07, Geol., Imperial Geological Survey, Tokio, Japan; Curator, Imperial Museum, Imperial Geological Survey. 1912-15, Geol., Field Geological & Geographical Survey, Middle & Southern China. 1915-17, Geographical and geological research work, Tokio, Japan. 1917-18, Supt., Oil expedition in B. North Borneo.

**Carleton Edwin Nordale**, Milwaukee, Wis.

Present position—1917 to date: Sales Engr., Allis-Chalmers Mfg. Co.

Proposed by Ernest C. Johnson, Joseph Furlong, John Edwin.

Born 1890, Minneapolis, Minn. 1909-11, Univ. of Minn. 1913-15, Mich. College of Mines. 1911-12, Engr., Utah Copper Co. 1912-13, Mining, Utah Mines

& Cœur d'Alenes. 1915-16, Chem., Marsh Min. Co., Wallace, Ida. 1916, Engr., Tenn. Copper Co. 1917, Chief Engr., Johnson Engrg. Wks. 1917 to date, Sales Engr., Allis-Chalmers Mfg. Co.

**Samuel Oakley, Taylor, Pa.**

Present position: Colliery Supt., Greenwood Colliery, The Hudson Coal Co., Moosic, Pa.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1865, England. 1871-78, Common school. 1880-87, Science & Art Dept., South Kensington, London. 1897-19, Mine Foreman, Del. & Hudson Coal Co. & Hudson Coal Co.

**George Oberlin, Santa Rosalia, Lower Calif., Mex.**

Present position—1917 to date: Asst. Mgr., Campagnie du Boles.

Proposed by Willard V. Morse, R. F. Barker, H. Y. Walker.

Born 1883, Colmar, Alsace. 1902-05, École Centrale des Arts & Mfrs., Paris, M. E. 1907-11, Head Min. Engr., Compagnie du Boles, Mex. 1912-14, Asst. Mgr., Société d'Études Minières en Indo-Chine, Hanoi. 1914-17, Officer in French Army.

**Louis Charles Penhoel, Los Angeles, Cal.**

Present position: Sec. & Treas., Southwestern Engrg. Co.

Proposed by W. F. Staunton, Alvord B. Carpenter, Edward E. McIntyre.

Born 1882, St. Louis, Mo. 1897-1901, Mech. Arts School, St. Paul, Minn. 1901-03, Univ. of Minn. 1904-06, S. D. School of Mines, B. S. 1906-07, Assayer & Millman, Grand View Min. Co., Silver City, S. D. 1908, Miner, Homestake Min. Co., S. D. 1909, Millman, Wasp No. 2, S. D. 1909-11, Duncan Mine, Atlantic City, McLaughlin & Ogden, Deadwood, S. D. 1912, Engr., B. E. Russell, Nacozari, Son., Mex. 1912-14, Engr., Gueriguito Min. Co., Sonora, Mex. 1914-16, Asst. Concentrator Supt., Moctezuma Copper Co., Sonora, Mex. 1916 to date, Cons. Wk., Southwestern Engrg. Co.

**Robert D. Pike, San Francisco, Cal.**

Present position: Cons. Chem., Engrs.

Proposed by Frank H. Probert, George H. West, L. H. Duschak.

Born 1885, San Francisco, Cal. 1902-05, Stanford Univ. 1905-07, Univ. of Cal., A. B. 1914-16, Chem. Engr., Western Carbon Co., Richmond, Cal. 1916-17, Writing reports, Chem. Div., on Pa. Coast. 1917, Cons. Eng., Stockton Tin & Enamel Brick Co., Magnesia & clay wk., in charge of wk. 1917-19, Cons. Engr., Mineral Products Co., Ltd. 1917 to date, Gen'l cons. wk.

**John H. Pritchard, Scranton, Pa.**

Present position: Colliery Supt., Von Storch Colliery, The Hudson Coal Co., Greenridge, Pa.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1869, Wales. 1875-91, Public School, Scranton, Pa. 1903-16, Mine Foreman; 1916-19, Colliery Supt., Hudson Coal Co.

**Ernst Prochaska, Bonne Terre, Mo.**

Present position: Designer, St. Joseph Lead Co.

Proposed by C. K. Hitchcock, Jr., Charles H. Briggs, N. A. Stockett.

Born 1862, Prague, Bohemia. 1872-78, Real School, Vienna. 1878-82, Polytechnikum Vienna and Gratz, M. E. 1886-88, Asst. Supt., Pottstown Iron Co. 1888-94, Chief Engr., Bessemer Rolling Mills, Bessemer, Ala.; Supt. Jefferson Steel Co., Birmingham, Ala.; Cons. Engr. 1894-96, Supt. Otis Steel Co., Cleveland, O. 1896-97, Chief Draftsman, J. P. Witherow Co., Newcastle, Pa. 1897-92, Chief Engr., Uehling Co., Ltd., Birmingham, Eng. 1900-03, Chief Draftsman, Walter Kennedy, Pittsburgh, Pa. 1903-06, Resident Engr., Roberts & Schaefer Co., Chicago, Ill. 1906-15, Chief Engr., American Coal Washer Co., Alton, Ill. 1915-17, Designer, Tenn. Copper Co.; American Zinc, Lead & Smelt. Co.; Bethlehem Steel Co.; St. Louis Smelt. & Refin. Co. 1917-19, Supt., Coal Washery of U. S. Fuel Co., Middle Fork, near Benton, Ill.

**Frank H. Ramsey, Bayway, N. J.**

Present position: Research Chem., Standard Oil Co.

Proposed by S. A. Taylor, D. J. McAdam, Jr., Isaac Harter.

Born 1888, Pittsburgh, Pa. 1907-10, Univ. Pittsburgh, B. S. 1910-11, Junior Chem., U. S. Bureau of Mines, Pittsburgh, Pa. 1911-12, Asst. Chem., Robert W. Hunt & Co., Pittsburgh, Pa. 1912-14, Chem., Phillips Sheet & Tin Plate Co., Steubenville, Ohio, Pope Plant. 1914-15, Teaching, Fellow School of Chem., Univ. Pittsburgh. 1915-19, Research Chem., Babcock & Wilcox Co., Bayonne, N. J.

**Louis I. Reh fuss, La Crosse, Wis.**

Present position: Unemployed (just discharged from Service).

Proposed by S. H. Ball, H. H. Knox, John H. Allen.

Born 1888, La Crosse, Wis. 1907-13, Univ. of Wis. 1918, Imperial College of Science & Technology, M. A. 1910, Compassman & Geol., Iron River Dist., Mich. 1911, Geol., Lead River Area, Mich. 1913, Geol., Bogoslovsk Min. Est., Perm, Russia. 1913-16, Geol., Belgian Congo & Angola, Soc. of Forest & Mines. 1916-18, Geol., Western Siberia, Irtysh Corp.

**Herman Reinbold, Omaha, Neb.**

Present position: Pres., Reinbold Metallurgical Co.

Proposed by Walter T. Page, endorsed by American Electrochemical Society.

Born 1861, Lahr, Germany. Univ. of Strassburg, Univ. of Zurich, Switzerland, Ph. D. 1893 to date, Pres., Reinbold Metallurgical Co., Vice-Pres., Potash Reduction Co., Pres., Vulcan Coal Min. Co., Omaha, Neb.

**Albert Victor Reis, Huelva, Spain.**

Present position: Min. Engr. in charge, Huelva Copper & Sulphur Co., Ltd.

Proposed by W. P. Rutherford, E. Mackay Heriot, J. C. Vivian.

Born 1886, Edinburgh, Scotland. 1893-1903, Edinburgh Royal High School. 1903-08, Heriot Watt Coll. 1905-08, Edinburgh Univ., B. Sc. 1910-11, Glasgow Univ. 1909-12, Coal min. experience, Allanton Collieries, Hamilton, Lanarkshire. 1912-19, Surveyor, Min. Engr. & underground operations, Tharsio Sulphur & Copper Co., Ltd., Huelva, Spain.

**William James Rich, Washington, D. C.**

Present position: Principal Examiner, U. S. Patent Office.

Proposed by Guillian H. Clamer, Bradley Stoughton, W. R. Walker.

Born 1859, Pembroke, Maine. 1872-77, Grammar & High Schools, Pembroke, Me. 1878, Maine State College. 1881-84, Mass. Inst. Tech., S. B. 1884-85, Asst. to Prof. R. H. Richards, Mass. Inst. Tech. 1885-86, Asst. Chem., Lab., Cambria Steel Co., Johnstown, Pa. 1886-89, Asst. in office of proprietors of locks & canals, on Merrimack River, Lowell, Mass. 1889-1903, Asst. Exam., U. S. Patent office, Washington, D. C. 1903-19, Principal Examiner, U. S. Patent Office. 1907-19, in charge of division of examining apps. for patents in met. heat treatment of metals, metal founding & electro chem.

**Alf Liljidlund Rosenlund, Kristiania, Norway.**

Present position—1915 to date: Geol. Min. Engr., Kristiansands, Nikkelraffineringswerk.

Proposed by Anton Gronningsater, V. Hybinette, W. A. Carlyle.

Born 1886, Bergen, Norway. 1895-1904, Kalhedralsskolen grammar school. 1904-05, Army officers' college. 1906-10, Univ. of Kristiania, M. E. 1910-12, Dr. in Mineralogy & Geol., Troudlyeins Tekinske Hoiskole. 1912-15, State Min. Geol., and Director, Norwegian Geol. Survey.

**Jacob Schoder, Whitepine, Colo.**

Present position: Mill Supt., Akron Mines, Colo.

Proposed by James E. Dick, John N. Teets, John Leo Towne.

Born 1889, Denver, Colo. 1902-07, Golden High School. 1907-09, Colo. School of Mines. 1909-10, Roll Operator, Pa. Min. Co., Montezuma, Colo. 1910, Table Operator, Western Chem. Co., Denver, Colo. 1911, Mill Shift Boss, Marion Mines, Fairview, Colo. & Mill Shift Boss, Montezuma Min. & Devel. Co., Ashcroft, Colo. 1912, Mill Supt., Bonanza Min. Co., Bonanza, Colo. 1913-14, Asst. Supt., Sutton, Steele & Steele Co., Denver, Colo. 1914-15, Const. Supt., Mt. Champion Min'g. Co., Leadville, Colo. 1915 to date, Mill Supt., Akron mines.

**Alfred Reginald Schultz, Hudson, Wis.**

Present position: Mgr., Burkhardt Mill. & Elec. Power Co.

Proposed by George O. Smith, David White, Max W. Ball.

Born 1876, Tomah, Wis. 1893-96, Tomah High School. 1896-1900, Univ. of Wis., B. S. 1902-04, Univ. of Wis. 1904-05, Univ. of Chicago, Ph. D. 1902-03, Resident Hydrologist of Wis. 1903-04, Charge of Luth Exploration Party, Canada. 1905-10, Geol., U. S. Geological Survey. 1910-11, Barber Asphalt Co., Trinidad, B. W. I. 1912-18, Geol., U. S. Geological Survey & Fuel Administration. 1918-19, Mgr., Burkhardt Nutting & Electric Power Co.

**Edgar Sengier, Brussels, Belgium.**

Present position: Mgr., Union Minière du Haut Katanga.

Proposed by Millard K. Shaler, S. H. Ball, Edgar Rickard.

Born 1879, Courtrai, Belgium. 1897-1904, Jesuites, Mons., E. E. & C. M. E. 1905, Asst. to H. N. Blake, Cons. Engr., Birmingham, Ala. 1906, Mgr., copper coke-oven plant, Melelroeck. 1906-11, Asst. Agent & Agent, Banque d'Outremer, Shanghai. 1911-19, Chg. of Tech. Depts., Union Minière du Haut Katanga Mines.

**Yoshio Shinjo, Kawasaki, Japan.**

Present position: Managing Director & Pres., & Chief Engr., Tokyo Elec. Co., Ltd.

Proposed by David B. Rushmore, W. R. Whitney, Arthur W. Jones (N. M.), Gerard Swope (N. M.).

Born 1873, Iwakuni, Yamaguchikan, Japan. 1898, Tokyo Imperial Univ., Tokyo. 1899 to date, Chief Engr.; 1899-1918, Mgr., Mfg. Dept.; 1902-18, Mgr., Sales Dept. 1915, Director; 1918, Pres., Research Lab., Tokyo Electric Co., Ltd.

**I. Philip Silverstein, Cleveland, Ohio.**

Present position: Met., The Electric Steel & Forge Co.

Proposed by S. H. Pitkin, Robert R. Abbott, James H. Herron.

Born 1885, Suwalki, Russia. 1907-08, Mich. College of Mines. 1908-12, Columbia School of Mines, E. M. 1915-16, Univ. of Wis., Ch. E. 1912-13, Tech. Asst. to Supt., Lake Superior Smelt. Co., Dollar Bay, Mich. 1913-15, Designer on elec. furnaces & gas producers, Wellman-Seaver-Morgan Co., Cleveland, Ohio. 1916-19, Met. in charge of elec.-furnace operations & Gen'l Supt., Crucible Steel Forge Co., Cleveland, Ohio.

**Edward Eggleston Smith, St. Aimé, Algeria.**

Present position—1913 to date: Algerian Mgr. and Geol. for S. Pearson & Son, Ltd., Ain Zeff Oil Co., Ltd., & Société d'Etudes, de Recherches & d'Exploitation des Pétroles en Algérie.

Proposed by A. C. Veatch, Roderic Crandall, E. DeGolyer.

Born 1883, Sioux City, Iowa. 1888-97, Public school, Sioux City, Iowa. 1897-1901, High School, Sioux City, Iowa. 1902-06, Univ. of Chicago, Associate Degree Science. 1906-10, Field Asst., Topographic Aide, Geol. Field Party, Wyoming; Geol., mine sampling, etc., State of Washington, U. S. Geological Survey. 1910, Geol., field party, Coeur d'Alene Dist., Ida.; Geol., Bermudez Co., Petrol. Devel. Branch; Gen'l Asphalt Co. of America in Venezuela. 1912-13, Geol., petrol. invests., S. Pearson & Son, Ltd., in Morocco.

**James Albert Smith, Albert, Tucker Co., W. Va.**

Present position—1907 to date: Min. Engr., Cumberland Coal Co. & Gorman C. & C. Co. & The Piedmont Min. Co. of Md.

Proposed by David B. Reger, Jabez B. Hanford, H. C. Greer.

Born 1881, Frostburg, Md. 1887-97, Beall High School, Inter. Corres. School, American School of Corres. 1899-1900, Miner, Union Min. Co., Md. 1900, Shot-firer, Southern Coal & Trans. Co., W. Va. 1900-05, Miner & Mine Laborer. 1905-06, Chainman, Engr. Corps; 1906, Transitman, Davis Coal & Coke Co. 1906-07, Resident Engr., Coketon & Oakmont Collieries, Davis Coal & Coke Co.

**Charles W. Snow, Platteville, Wis.**

Present position: Ore Purchasing Agent, Federal Lead Co., Federal, Ill.; Ill. Zinc Co., Peru, Ill.

Proposed by A. M. Plumb, J. N. Houser, William N. Smith.

Born 1879, Avoca, Wis. 1898, Univ. of Wis. 1904-05, Mineral Point Zinc Co., DePue, Ill. 1905-19, Assayer & Chem., Chg. of Lab., Illinois Zinc Co., Platteville, Wis.

**Clarence W. Spicer, Plainfield, N. J.**

Present position—1915 to date: Vice-pres. & Chief Engr., Spicer Mfg. Corp., So. Plainfield, N. J.

Proposed by Richard Moldenke, Henry D. Hibbard, George William Sargent.

Born 1875, Edelstein, Ill. 1891-94, Alfred Univ. 1900-04, Cornell Univ. 1904-15, Pres., Spicer Mfg. Co., Plainfield, N. J.

**Percival Lancefield Stockdale, Pachuca, Hid., Mex.**

Present position—1918 to date: Mill Supt., Neg. Minera San Rafael y Anexas.

Proposed by R. Hay Anderson, Fred MacCoy, Herbert F. Carter.

Born 1887, Queretaro, Mex. 1902, Mex. City H. S. 1904-05, Assayer, Garduno

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS lxi

**Min. Co., Est. de Guerrero, Mex.** 1905-07, Sampler, El Oro Min. & R. R. Co., El Oro, Mex. 1907-08, Zinc Room Foreman, Guanajuato Amalgamated Gold M. Co., La Luz, Mex. 1908-09, Shift Boss, cyanide plant, Guerrero Mill, Hig., Mex. 1909-14, Zinc Room Foreman, Santa Gertrudis, Pachuca, Mex. 1914-15, Met., Cinco Minas Co., Jalisco, Mex. 1915-16, Assayer, Seneca Gold Mines Co., Seneca, Plumas Co., Mex. 1916-17, Charge of Bolanos mines, F. W. Oldfield, Mex.

**Archibald Jackson Strane, Tamaqua, Pa.**

Present position—1917 to date: Explosives & Min. Engr., Atlas Powder Co., Wilmington, Del.

Proposed by George S. Rice, J. W. Paul, Edward Steidle.

Born 1887, Ellendale, N. D. 1906, High School, St. Paul, Minn. 1910, Univ. of Minn., E. M. 1910-11, U. S. G. S. topographical & sub-div. wk., Mont., Ariz., & Nev. 1911-14, Jr. Min. Engr., U. S. Bureau of Mines, Pittsburgh Experiment Sta. 1914-17, Asst. Explosives Engr., Explosives Physical Testing, U. S. Bureau of Mines, Pittsburgh, Pa.

**David Alexander Sutherland, London, England.**

Present position: Cons. Engr.

Proposed by Ralph Arnold, David White, Chester W. Washburne.

Born 1863, Glasgow, Scotland. 1874-79, Edinburgh Academy. 1879-82, Edinburgh Univ. 1882-83, Glasgow Univ. 1883, Anderonie College, Glasgow, F. I. C. 1880-82, Asst. to Dr. Drinkwater, in Chem. & Met., Edinburgh Univ. 1883, Asst. to Dr. Wallace, City Analyst, Glasgow, Research Asst., Anderson Colliery, Glasgow. 1883-86, Chem. & Asst. Mgr., Clippans Oil Co., Johnsons, N. B. 1886-89, Anly. advisor, Burmisland Oil Co., Burmisland, N. B. 1889-90, Cons., Whit-haven Cumberland & Met., Whithaven Scientific Inst. & College. 1890-93, Partnership with G. J. Snelus, F. R. S. 1893 to date, Cons. Engr.

**Masao Suzuki, New York, N. Y.**

Present position—1917 to date: Mgr., Hikoshima Zinc Smelter.

Proposed by W. George Waring, Charles T. Orr, P. B. Butler, Victor Rakowsky, F. C. Wallower.

Born 1883, Japan. 1907-10, College Engrg., Tokyo Imperial Univ., Tokyo, Japan, M. E. 1910-16, Supt., Osaka Zinc Smelt. Co.

**Samuel Vanderburgh Tench, Wilkes-Barre, Pa.**

Present position—1915 to date: Div. Supt., Wilkes-Barre Div., Hudson Coal Co.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1867, Pittston, Pa. Pittston High School. 1889-1904, Foreman, Lehigh Valley Coal Co., Wilkes-Barre, Pa. 1904-09, Supt., Red Ash Coal Co., Wilkes-Barre, Pa. 1909-14, Supt., Lehigh Coal & Navigation Co., Lansford, Pa. 1914, Agent, Lehigh Oil Co., Luzerne, Pa. 1914-15, Special Engr., E. T. Conner, Scranton, Pa.

**Leonard Giles Thomas, Morococha, Peru.**

Present position: Constr. Engr., Cerro de Pasco Corp'n.

Proposed by E. E. Barker, T. W. Mather, John M. Boutwell.

Born 1889, Santa Cruz, Calif. 1910-11, Ohio State Univ. 1907-13, New Mexico, College of A. & M. A., B. S. 1912, Field Clerk & Instrumentman, U. S. Gen'l Land Office, Santa Fe, N. M. 1913, Asst. Co. Road Engr., Las Cruces, N. M. 1914-15, U. S. Surveyor, U. S. Engr. Dept., Cleveland, Ohio. 1915, Asst. Engr., Chino Copper Co., Hurley, N. M. 1916-18, Engr., Chile Exploration Co., Chile.

**James William Tippet, Butte, Mont.**

Present position—1916 to date: Foreman, East Colusa mine, Anaconda Copper Min. Co.

Proposed by C. L. Berrien, John Gillie, F. A. Linforth.

Born 1875, Cornwall, England. 1879-88, Public Schools, Eng. 1899-1900, Business College, Butte, Mont. 1904-08, Inter. Corres. School. 1889-91, Miner, tin mines, England. 1892-93, Min., Alice Min. Co., Butte, Mont. 1894-96, Min., Butte & Boston Co., Butte, Mont. 1897-1904, Min.; 1905-10, Boss Timberman, East Colusa mine; 1910-16, Shift Boss, East Colusa mine.

**Wienand Traugott Tolch, Thane, Alaska.**

Present position: Chief Engr., Alaska Gastineau Min. Co.

Proposed by G. T. Jackson, B. L. Thane, P. R. Bradley.

Born 1881, Bremen, Germany. 1887-98, Gymnasium, Bremen, Germany. 1899-1900, Tech. Jemenau. 1901-06, Draftsman & Instrumentman, Westinghouse

**Air Brake Co., Chicago, Milwaukee & St. Paul.** 1906-07, Constr. Engr., Du Pont Powder Co., Santa Cruz, Calif. 1907-11, Partner, Prowell Engrg. Co., Wenatchee, Wash. 1911-12, Office Engr., San Francisco, Oakland Terminal Railways. 1913-14, Asst. Engr.; 1915-18, Supt., Transportation, Alaska Gastineau Min. Co., Juneau, Alaska.

**David S. Tovey,** Flower, Ont., Canada.

Present position: Supt., Caldwell mine.

Proposed by Ralph E. Davis, W. N. Smith, J. A. MacCulloch.

Born 1884, Olyphant, Pa. 1909-10, Highland Park School. 1913-15, Wis. Mining School. 1907-09, Engrs. Asst. & Engr. 1910-13, Engr., Sultan & Wayne, Globe, Ariz. 1915-17, Asst. Geol., Vinegar Hill Zinc Co., Platteville, Wis. 1917-18, Field Engr., Grasselli Chem. Co., Cleveland, O. 1918 to date, Supt., Caldwell Mines, Grasselli Chem. Co.

**Firmin Van Breé,** Brussels, Belgium.

Present position: Cons. Engr. Société Générale de Belgique.

Proposed by M. K. Shaler, S. H. Ball, Edgar Rickard.

Born 1880, Brussels, Belgium. 1896-1903, Univ. of Louvain, C. E. 1907-19, Cons. Engr., to the Société Générale de Belgique; secretary, technical adviser, manager or director from different companies controlled by the Société Générale as Union Minière du Haut Katanga, Société Internationale Forestière et Minière du Congo, Société Métallurgique, Hoboken, Société du Nickel de la Néthe, Société Navale de l'Océanie, etc.

**Sterling E. Van Horn,** Scranton, Pa.

Present position—1916 to date: Colliery Supt., Olyphant & Eddy Creek Collieries, Hudson Coal Co., Pa.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1870, Wilkes-Barre, Pa. 1887, Public Schools of Wilkes-Barre, Pa. 1889-97, Engrg. Dept., Lehigh Valley Coal Co. 1897-1910, Div. Engr. of Mines, D. & H. Coal Co. 1910-15, Asst. Chief Engr. of Mines; 1915-16, Chief Engr. of Mines, D. & H. Coal Co.

**Bruce Wade,** Nashville, Tenn.

Proposed by Joseph Kent Roberts, Frank A. Wilder, C. E. Garland.

Present position: Asst. State Geol. of Tenn.

Born 1889, Trenton, Tenn. 1909-14, Vanderbilt Univ. 1914-17, Johns Hopkins Univ., B. S., M. S., Ph. D. 1913-17, Summer & early fall months, Asst. Geol., Tenn. Geological Survey. 1917 to date, Part time in army, & Asst. State Geol.

**John J. Walsh,** Wilkes-Barre, Pa.

Present position: Asst. Div. Supt., Wilkes-Barre Div., The Hudson Coal Co.

Proposed by C. Dorrance, R. H. Buchanan, R. Y. Williams.

Born 1875, Jersey. Attended Public Schools. 1901-02, Mine Foreman, Hill-side Coal & Iron Co., Scranton, Pa. 1902-16, Mine Engr. & Asst. Supt., West End Coal Co. 1916-17, Special Engr.; 1917-19, Asst. Div. Supt., Hudson Coal Co.

**Romaine George Waltenberg,** Washington, D. C.

Present position: Associate Physicist, Bureau of Standards.

Proposed by Paul D. Merica, George K. Burgess, Edward C. Groesbeck.

Born 1889, Tomah, Wis. 1904-08, Baltimore Polytechnic Inst. 1910-12, Univ. of Wis., B. S. 1908-09, Asst. Chem., Baltimore Copper Smelting & Rolling Co. 1909-10, Asst. Chem., Baltimore Cons. Gas. Co. 1912, Asst. Physicist, Bureau of Standards.

**Evan B. Williams,** Carbondale, Pa.

Present position: Colliery Supt., Jermyn Colliery, Hudson Coal Co., Jermyn, Pa.

Proposed by R. Y. Williams, R. H. Buchanan, C. Dorrance.

Born 1883, Havod, South Wales. 1905-06, Williamsport Seminary. 1912, International Correspondence School. 1907-09, Asst. Mine Foreman, Clinton Colliery. 1910-17, Contracting & robbing pillars, No. 1 Colliery. 1917-19, Colliery Supt., Hudson Coal Co.

**Walter B. Wilson,** Tulsa, Okla.

Present position: Geol., Gypsy Oil Co.

Proposed by George C. Matson, James H. Gardner, Stanley C. Herold.

Born 1885, Ft. Madison, Iowa. 1913-14, Univ. of Mo., A. B. & A. M. 1915-16, Univ. of Chicago. 1913, summer, Field party, Wind River Mts., Wyo. from Univ

of Mo. 1914, Geol. Aid, U. S. Geol. Survey, Mont. 1915, Geol. Aid, U. S. G. S. Oil Shale investigations, in Colo. & Wyo. 1916, Geol. Aid, U. S. G. S. in Utah. 1917, Geol., Gypsy Oil Co., Tulsa, Okla.; field investigation, Columbia, S. A. 1918, Field wk. in La., Okla., Mont., Wyo., Colo., & N. Mex. for Gypsy Oil Co. 1919, Field wk., Columbia, S. A. & Okla.

**Dean E. Winchester**, Washington, D. C.

Present position: Geol., U. S. Geological Survey.

Proposed by K. C. Heald, David White, Ralph Arnold.

Born 1883, Gibbon, Neb. 1901-06, Univ. of Neb., B. Sc. 1906-19, Geol., U. S. Survey.

**Oliver Holmes Woodward**, Mount Morgan, Queensland, Australia.

Present position: Met. Engrg. Staff, Mount Morgan Gold Min. Co., Ltd., Queensland.

Proposed by A. A. Boyd, James Horsburgh, E. Noel Goode.

Born 1887, Tenterfield, N. S. W. 1900-05, Newington Coll., Sydney. 1908-10, Queensland Govt. School of Mines, Charters Towers, M-E.M. 1906, Practical Min. Exp., Glen Smelt. Co., Ltd., Tent Hill, N. S. W. 1907-08, Mine Survey Dept. Ironbark Min. Co., Ltd., Queensland. 1908-10, Passed Govt. Ex. Queensland Dept. of Mines & awarded 1st class certificate of competency as Mine Mgr. 1911-12, In chg. volumetric laboratory, Ironbark Min. Co., Ltd.; Mine Surveyor, Ironbark Min. Co., Ltd. 1912-13, Undergrd. timbering exp., Central mine, Broken Hill, N. S. W. 1913-15, Min. Engrg. Staff, Mount Morgan Gold Min. Co., Ltd., Queensland. 1915-19, Lieut., Capt., Aust. Army.

### Associates

**Harvey Delbert Austin**, Platteville, Wis.

Present position: Surveyor, Wisconsin Zinc Co.

Proposed by K. K. Hood, A. M. Plumb, Ralph E. Davis.

Born 1896, Platteville, Wis. 1901-10, Platteville P. S. 1911-14, Platteville H. S. 1914-16, Wis. Min. School. 1915, Millman in concentrating plant remilling tails, Rowe Min. Co. 1916-18, Surveyor, Wis. Zinc Co., Platteville, Wis. 1918-19, Signal Quartermaster, U. S. N.

**Victor Gordon Crawford**, Emmaville, N. S. W., Australia.

Present position—1916 to date: Asst. Mgr., Vegetable Creek Tin Mine.

Proposed by George Smith, William H. Corbould, G. H. Blakemore.

Born 1887, Dandeney, Victoria. 1898-1904, Melbourne Church of England Grammar School. 1905-09, Melbourne Univ., E. M. 1910-13, Underground wk., Mount Morgan mine, Queensland. 1913, Asst. Surveyor, Central mine, Broken Hill, N. S. W. 1913-15, 1 yr., Underground Shift Boss, Mount Morgan mine; 1 yr., Asst. Surveyor, for co. 1915-16, Asst. Engr., R. R. constr., Queensland, R. R.

**Stephen Woodhouse Dean**, Chase View, Coppenhall, Stafford, Eng.

Present position: Wks. Mgr., The Delta Metal Co.

Proposed by Alford G. C. Gwyer, C. H. Mathewson, Charles Ferry.

Born 1893, London, England. Christ College, Blackheath; Univ., Sheffield. 1909-12, Engr., The Delta Metal Co., Ltd. 1914-17, Chem., Admiralty Inspection Dept., Sheffield. 1917, Works Mgr., The Delta Metal Co., Ltd.

**Otto Henry Heil**, Lakewood, Ohio.

Present position—1918 to date: Technical Apprentice, Aluminum Castings Co., "L" Plant, Cleveland, Ohio.

Proposed by R. H. Allport, T. D. Stay, R. S. Archer.

Born 1893, Cleveland, Ohio. 1908-12, Cleveland High School of Commerce. 1913-17, Case Sch. of Applied Sci., B. S. 1917-18, Min. Engr., Pickands Mather & Co., Gilbert, Minn. 1918, 2d Lieut., Coast Artillery Corps, Fort Monroe.

**Lewis Bieber Kramer**, Mt. Penn, Pa.

Present position: Melter, Elec. Furnace, Carpenter Steel Co., Reading, Pa.

Proposed by J. F. Kramer, B. H. Delong, R. V. Luerssen.

Born 1896, Phillipsburg, N. J. 1911-13, Mercersburg Academy. 1913-17, Lehigh Univ., Elmet. 1917, summer, Helper, elec. furnace, Lebanon Steel Fdry., Lebanon, Pa. 1917-18, Chem. & Melter, Driscoll-Reese Steel Co., Harrisburg, Pa. 1918, summer, Helper, elec. furnace, Wm. Wharton, Jr. & Co., Inc., Easton, Pa. 1918-19, U. S. A.

**George Warren La Peire**, Tulsa, Okla.

Present position: Geol., South Am. Gulf Refin. Co.

Proposed by A. H. Garner, Howard F. Nash, J. Whitney Lewis.

Born 1892, Mayfield, Calif. 1911-16, Stanford Univ., A. B. 1916-17, Geol., Empire Gas & Fuel Co., Bartlesville, Okla. 1917-18, Lindgren & Co., San Francisco, Calif. 1918-19, U. S. A., 2d Lieut. Engrs. 1919, Gulf Refin. Co., Pittsburgh, Pa.

**Richard Thomas Lyons**, Ft. Worth, Tex.

Present position: Oil Geol., Sinclair Gulf Oil Co., Texas.

Proposed by Jon A. Udden, Charles E. Locke, Carle R. Hayward.

Born 1895, East Weymouth, Mass. 1909-13, Weymouth High School. 1913-14, Univ. of Maine. 1914-17, Mass. Inst. of Tech., B. S. 1916, summer, Mucker, Tramway mine, Anaconda Copper Co., Butte, Mont. 1917, summer, Chem., Research on sulphatizing of Moa Bay iron ore at Mass. Inst. of Tech. 1917-19, 2d Lieut., U. S. A. 1919 to date, Oil Geol., Sinclair Gulf Oil Co., investigations in North Central Texas.

**Edwin S. Mills**, Chicago, Ill.

Present position: Gen'l Mgr., Sales Dept., Ill. Steel Co.

Proposed by A. N. Diehl, H. S. Stebbins, James Gayley.

Born 1870, New Brighton, Pa. 1895, Mgr., Sales, Dist. office, Cleveland, Ohio. 1896, Agent, Oliver Iron Min. Co., Cleveland, Ohio. 1898, Gen'l Mgr., Pittsburgh Steamship Co., Cleveland, Ohio. 1902, Asst. to First Vice-pres., United States Steel Corp., New York. 1909, Special Sales Agent, Carnegie Steel Co., Chicago, Ill. 1919, Gen'l Mgr. of Sales, Ill. Steel Co.

**David Max Morgan**, Joplin, Mo.

Present position: Geol., Atlantic Oil Producing Co., Dallas, Tex.

Proposed by A. Edmond Robitaille, Chester A. Hammill, Frederic H. Lahee.

Born 1891, Jackson, Ohio. 1906-10, Jackson High School, Colo. 1910-12, Colo. Ag. College Engrg. Course. 1913-15, State Normal School, Kans. 1916-17, Univ. Chicago, B. S. 1912-13, Rhul & Shanklin, Civil & Min. Engrs., Joplin, Mo. 1913-14, Tr. Manual Tr. Kingman, Kans. 1914-15, Prin. Westphalia Twp. H. S., Westphalia, Kans. 1915-16, Tr. Mech. Drawing & Math., Vinita High School, Okla. 1916-17, Student. 1917-18, Geol., Empire Gas & Fuel Co., Bartlesville, Okla. 1918-19, Lieut., Coast Artillery, Va. 1919, Geol., Cosden Oil & Gas, Tulsa, Okla.

**William Louis Niekamp**, St. Louis, Mo.

Present position: Pres. & Gen'l Mgr., Beck & Corbitt Iron Co.

Proposed by Eugene McAuliffe, L. E. Young, H. A. Buehler.

Born 1877, St. Louis, Mo. 1883-90, Clay School. 1890-92, Central High School. Since 1895, distribution of steel & metal in a jobbing way. 1900-07, Asst. Sec.; 1907-13, Vice-pres.; 1913 to date, Pres., Beck & Corbitt Iron & Steel Co.

**John Everett Rogers**, Rochdale, Mass.

Present position—1915 to date: Sec. & Met., F. P. Rogers, Jr.

Proposed by Leslie D. Hawkridge, Albert Sauveur, Herbert M. Boylston.

Born 1894, Rochdale, Mass. 1911-15, Harvard Univ., A. B.

**Alfred C. Royce**, Boston, Mass.

Present position—1918 to date: Testing Engr. and Met., Technical Staff, Met. Branch, U. S. A. Ordn. Dept.

Proposed by Lawford H. Fry, Orville Campbell Skinner, F. C. Langenberg.

Born 1890, Tonawanda, N. Y. Public School, High School, Prep. School, Univ. of Buffalo. 1913-15, Open hearth & blooming mill, Lackawanna Steel Co., Lackawanna, N. Y. 1915-16, Production of French & English shell steel, Donner Steel Co., Buffalo, N. Y. 1916-17, Acceptance of shell forgings (British 9.2), Gen'l R. R. Signal Wks., Rochester, N. Y. 1917-18, Inspection & acceptance of steel castings, Pierce Arrow Motor Car Co.

**Santos Soto, Jr.**, New York, N. Y.

Present position: Engr., Nicklas Min. Co., Battle Mountain, Nev.

Proposed by H. G. Humes, H. B. Menardi, H. B. Barling.

Born 1895, Tegucigalpa. 1912, George Washington Univ. 1913, Mass. Inst. of Technology. 1914-18, Freiberg, Sax., E. M. 1918, Engr., Frohburg Braunkohlenwerke, Freiberg, Saxony. 1919, Asst. Engr., Leichter Schenck, Borna, Leipzig. From July, 1918 to Dec., 1918, Civil prisoner in Germany.

**Shang-Sung Tang, Changsha, China.**

Present position—1918 to date: Min. & Met. Engr., Yu Seng Manganese Min. Co.

Proposed by Y. F. Chen, S. Ken Huang, William A. Wong.

Born 1891, Kui Kiang, China. 1901-09, William Nast College, Kinkiang, China. 1910-13, Baldwin Univ., Berea, Ohio. 1913-16, Case School of Applied Science, Cleveland, Ohio, B. S. & B. M. E. 1916, Chem., The Cleveland Furnace Co. & Asst. to Asst. Supt. 1917-18, Prof. of Geol. & Mineralogy, Fukien Christian Univ., Foochow, China, & Head of Dept.

**Thomas Smith Woods, Boston, Mass.**

Present position—1909 to date: Officer & Director of Mining Companies.

Proposed by George A. Packard, Henry N. Sweet, W. F. Bartholomew.

Born 1868, Bath, N. H. 1882-6, Boston Latin Sch. 1886-90, Harvard Univ., A. B. 1887-90, Student in geol. & field wk. under Profs. Shaler & Davis. 1913-19, Author maps of Mich., Bingham & Ely Dists., Illustrated Article "The Porphyry Intrusions of the Mich. Cop. Dist." 1909 to date, Dir. Bingham Mines Co.; Dir. South Lake Min. Co.; Jerome del Monte Cop. Co. 1917, Treas., Bingham Mines Co., Eagle & Blue Bell Min. Co. 1918, Pres., Winona Copper Co. 1919, Dir., Franklin Min. Co., North Lake Min. Co.

**John Young, Oglesby, Ill.**

Present position: Supt., Lehigh Portland Cement Co.

Proposed by J. A. Ede, Dibrell P. Hynes, Frances G. Fabian.

Born 1888, Leadville, Colo. 1902-08, Lansing College, England, & Birmingham Univ. 1908-12, Manufacturing min. mach., Chalmers & Williams, Inc. 1912-15, Cyanide & Mech. depts., El Oro Min. & Refin. Co., Ltd. 1915, Charge of Oglesby mill, Lehigh Portland Cement Co.

**Max Edward Ziege, Ely, Nev.**

Present position—1917 to date: Translation work, writing mining textbooks, chem. & geol.

Proposed by Emmet D. Boyle, Lindsay Duncan, G. C. Riser, Jr.

Born 1884, Lichtenstein, Germany. 1902-04, Technische Hochschule, Aachen. 1905-06, Academie D. Berg Bau, Leipzig. 1907-08, Public schools & night schools, Internatl. Corres. School. 1908-10, Worked at min. & mill. 1910-16, Min. & mill. & prospecting in U. S.

*Junior Associates*

**James Allison Buchanan, Hancock, Mich.**

Present position: Student, Mich. College of Mines, Houghton, Mich.

Proposed by F. W. Sperr, J. B. Cunningham, F. W. McNair.

Born 1896, Washington, D. C. 1913-18, George Washington Univ., Washington, D. C. 1918-19, Mich. College of Mines. 1914-15, Instrumentman, Panama Canal, Balboa Terminal. 1916, Precise Levelman, U. S. & Canada Boundary Survey. 1916-17, Computer, U. S. Coast & Geodetic Survey. 1917, Precise Levelman, U. S. & Canada Boundary Survey. 1917-18, Asst. Engr., Quiney Min. Co., Hancock, Mich.

**Lawrence Owen Casselman, Rolla, Mo.**

Present position—1916 to date: Student, Missouri School of Mines.

Proposed by Horace T. Mann, A. L. McRae, M. H. Thornberry.

Born 1897, Columbia, Mo. 1912-16, Willow Springs, Mo., H. S.

**Lorain Harry Cunningham, Rolla, Mo.**

Present position: Student, Mo. School of Mines.

Proposed by M. H. Thornberry, A. L. McRae, C. L. Dake.

Born 1895, Pleasanton, Kans. 1909-13, Cherokee Co. H. S. 1915-16, Kans. School of Mines. 1916-17, Mo. School of Mines. 1913-14, summer, Coal Miner, Central Coal & Coke Co., Pittsburg, Kan. 1917-19., First Lieut., 125th Field Artillery, A. E. F. 1919, summer, Plans & profiles of hard surface roads, field & office, Labette Co., Kansas.

**Gerard Ernest Etmeyer, Rolla, Mo.**

Present position: Student, Mo. School of Mines.

Proposed by M. H. Thornberry, Charles Y. Clayton, A. L. McRae.

Born 1890, Chicago, Ill. 1 yr. Univ. of Neb., 3 yrs. Mo. School of Mines. 1915, Flotation, Chino Copper Co., Hurley, N. M. 1917, Field Asst., Geol. Dept., Gypsy Oil Co. & Field Asst. U. S. G. S. Washington, D. C. 1917-19, U. S. Army.

**Clifford Peter Howard**, Rolla, Mo.

Present position: Student, Mo. School of Mines.

Proposed by G. H. Cox, C. L. Dake, C. R. Forbes.

Born 1898, Wilburton, Okla. 1913-15, Wilburton High School. 1915-17, Okla. School of Mines. 1917, Mo. School of Mines. 1915-16-17-18, summers, Gen'l mine wk., Degnan McConnell Coal & Coke Co., Wilburton, Okla. 1919, summer, Gen'l engrg. wk., Crystal Block Coal & Coke Co., Sprigg, W. Va.

**James Nathaniel McGirl**, Rolla, Mo.

Present position: Student, Mo. School of Mines.

Proposed by Charles Y. Clayton, M. H. Thornberry, A. L. McRae.

Born 1898, Odessa, Mo.

**John Gaines Miller**, Rolla, Mo.

Present position: Tech. Student, Mo. School of Mines.

Proposed by Charles Y. Clayton, M. H. Thornberry, A. L. McRae.

Born 1897, Marshall, Mo. 1904-12, Marshall Grade School. 1912-16, Marshall High School. 1916, Mo. School of Mines. 1918, Rodman & Chainman, Ariz. Copper Co., Ltd., Longfellow Div., Morenci, Ariz. 1918, Asst. Chem., mine assay office, Ariz. Copper Co., Morenci, Ariz.

**Ralph Marks Moon**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. McNair, F. W. Sperr.

Born 1895, Wilmette, Ill. 1915-16, Mich. College of Mines.

**Earl Nelson Murphy**, Rolla, Mo.

Present position: Student, Missouri School of Mines, Rolla, Mo.

Proposed by M. H. Thornberry, A. L. McRae, C. L. Dake.

Born 1894, Mount Zion, Iowa. 1914-17, Missouri Sch. of Mines. 1919, A. E. F. Univ., Beaune, France. 1917, summer, Min. in Joplin, Mo., Dist. 1917-19, 1st Lieut., U. S. Army.

**Meade W. Patterson**, Lockport, N. Y.

Present position: Student, Univ. of Michigan.

Proposed by E. D. Campbell, A. E. White, William Westerman.

Born 1893, Lockport, N. Y. 1908-12, Lockport H. S. 1913-17, Engrg. Coll., Univ. of Mich.

**Oscar Eli Stoner**, Rolla, Mo.

Present position: Student, Mo. School of Mines.

Proposed by M. H. Thornberry, Charles Y. Clayton, C. R. Forbes.

Born 1892, Chester, Neb. 1914-17, Mo. School of Mines & Met. 1915, Machine drill work, Plant Min. Co., Webb City, Mo. 1917-19, U. S. Army.

**Dwight Halbrook Thornburg**, Berkeley, Cal.

Present position: Student, Mining College, Univ. of California.

Proposed by Frank H. Probert, Lester C. Uren, Ernest A. Hersam.

Born 1895, Long Beach, Cal. 1913-14, Junior Col. 1919, Univ. of California. 1914-15, Miner & Hoist Engr., George H. Otter Min. Co., Silver City, N. M. 1915, Miner, Calumet & Arizona Co., Bisbee, Ariz. 1915-17, Pumpman, Los Angeles City Water Dept. 1917-19, U. S. Army, Asst. Engr. 1919, Centrifugal pump & motor installation, San Fernando dam, City Water Dept.

**Thomas Patrick Walsh**, Rolla, Mo.

Present position—1913 to date: Mo. School of Mines.

Proposed by M. H. Thornberry, Charles Y. Clayton, G. H. Cox.

Born 1896, St. Joseph, Mo. 1917, 2d Lieut., C. A. C.

### *Change of Status—Junior Associate to Associate*

**Arthur C. Mallams**, Pittsburg, Kans.

Present position: Mgr., Pittsburg Engrg. Co.

Born 1895, Weir City, Kans. 1912-17, Kansas State School of Mines. 1912-13, summer, Chainman & Rodman, Central Coal & Coke Co., Pittsburg, Kans. 1913, Asst. Min. Engr., Crowe Coal & Min. Co., charge of underground work. 1913-14, Asst. Min. Engr., Central Coal & Coke Co., Asst. Civil Engr., Missouri & Louisiana R. R. 1914, Chief Engr., Mallams-Halstead Coal Co., Weir, Kans. 1915, Engr., Union Ice & Coal Storage Co. 1917-18, Private practice, charge of several coal min. properties. 1918-19, Civil & Min. Engr., charge of underground, Southern Illinois Engrg. Co.

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## Oxygen in Cast Iron and Its Application

Discussion of the paper of W. L. STORK, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 951.

R. MOLDENKE, Watchung, N. J. (written discussion\*).—It is somewhat difficult to discuss the paper of Mr. Stork, when the description of the cupola melting occurrences indicates that his practice is open to question. The evident burning of much of the steel charged, coupled with the remarkably low silicon content of the mixture as shown by the resulting product, throws the entire melting practice into that of making cupola malleable. If anything is wanted here, it is a high bed to melt upon, and yet Mr. Stork in the very beginning of his paper speaks of the evils of oxidation due to a "high" bed, etc. The experienced foundryman would judge at the outset that Mr. Stork has kept his bed in the cupola too low, and naturally got a lot of oxidation from the blast.

The oxidation of steel when used in large quantities in cupola mixtures is a well-known phenomenon, and is readily understood. One has but to put a file into the forge fire and watch it burn when heated high enough. The melting point of steel being higher than cast iron, heavy pieces may dig way into the bed before being completely melted away, the last portions being directly exposed to free oxygen from the blast. Another situation not to be forgotten is the oxidizing effect of carbon dioxide at high temperatures. A serious oxidation of the steel is quite conceivable if in the zone of maximum carbon dioxide and minimum carbon monoxide—free oxygen being entirely absent. Hence the well understood practice of never melting a mixture with much steel unless the bed is kept exceedingly high; or again the above-mentioned malleable practice.

Mr. Stork mentions the impossibility of deoxidizing a heat after the steel contained has been oxidized. This is true to a great extent with the ordinary deoxidizers, such as silicon and manganese, but can be brought about by vanadium, titanium, magnesium, etc. Proper melting, however, makes this unnecessary.

Mr. Stork differentiates between the oxygen taken up by melting steel and that by ordinary mixtures under improper melting conditions. It is difficult to understand this contention. To the experienced foundry metallurgist, there seem to be but two forms of iron oxide to be reckoned with in cupola melting. One is the rust or surface oxidation particularly

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\* Received June 30, 1919.

prevalent in such material as stove-plate scrap, and the other the oxide actually within the metal, as in "burnt" grate bars, soda kettles, furnace plates, etc. Rust is simply taken up in the slag, but the other form enters the molten metal and more or less of it remains dissolved therein, depending upon the opportunity given to react with manganese, silicon and carbon. This depends in turn upon the temperature and the mobility of the molecules. Unless it is hot enough to allow of a reaction and the mixing is intimate enough, oxygen and carbon, in fact manganese and sulfur, will in the common iron vehicle flow out side by side over the cupola spout into the ladle, get into the mold and actually sometimes get together while in the mold, with disastrous results to the machining qualities and soundness of the castings.

No matter what may be brought up in the way of photomicrographs of oxygenated iron, etc., there does not appear to be the slightest effectual difference between this and a burnt soda-kettle iron, when both have been melted again. Indeed, the instance cited by Mr. Stork, of the boiling action of green ladles, does not differ from Johnson's oxygenation. If continued too long it is bad, but in slight measure the higher combined carbon produced yields a stronger metal. The foundryman knows this and on occasion uses the homely method of spitting a potato on an iron rod and poking it down into the ladle, with beautiful boiling effects.

To take up the six points mentioned by Mr. Stork as summarizing the oxygen effect on cast iron, the following may be said: The fact that cast iron containing oxygen solidifies at a higher temperature than cast iron free from this element was probably first pointed out by me many years ago and continually dwelt upon, so that now it is generally recognized as true. Every foundryman knew that what he called "burnt" iron set faster and had little "life." He did not know that dissolved oxide of iron caused this, scientifically speaking, raising of the "freezing point." It is with considerable satisfaction that I now see my years of contention for the recognition of oxygen in cast iron accepted by eminent metallurgists who scouted the idea until the work of the late J. E. Johnson, Jr., started a controversy.

Further, that cast iron containing oxygen has more combined carbon than that without it is the very contention made by those who oppose Johnson's theory that oxygen is directly the cause of higher strength, chilling power and hardness. Foundry metallurgists have always agreed with this after they became familiar with the oxygen situation. They hold that not the oxygen is the cause of strength, etc., but the effect oxygen has on raising the freezing point and thereby increasing the combined carbon by quicker setting of the metal brings this about. There results a deeper chill, greater hardness and higher strength.

I further hold that these seemingly beneficial effects are heavily discounted by evils incident to the presence of oxygen, in the way of pin

holes, gas pockets, excessive interior shrinkage, cracks resulting from inability of the metal to stretch in setting, etc., which more than counterbalance the apparent gain. It is dangerous to fool with oxygen in cast iron, as the concealed defects of a casting may come out in most disagreeable fashion at a critical time.

Mr. Stork says that manganese added to metal high in oxygen takes up some of it and thereby reduces chilling power and strength. True, but this is because of a reduction in combined carbon. Outerbridge effected this many years ago by adding ferromanganese to his cast-iron car-wheel mixtures. He did not then know about the oxygen end of it, but overcame the difficulties this element caused and thereby got more reliable wheels.

Mr. Stork's statement that steel, when added to cupola mixtures, is oxidized and it is this oxygen content that gives such a mixture its "superior physical properties," I consider incorrect. It is the reduction in the total carbon brought about by steel additions that give the good qualities found in the resulting castings, the bad ones are attributable to the oxygen.

It is well known that the surface portion of a casting has a maximum of combined carbon, whereas the center of the heaviest section has the minimum. Graphite forms the complement of these figures, the sum of the two in each case, or total carbon, being practically uniform in amount throughout the casting. Unless, therefore, the sample for analysis for combined carbon and graphite is taken by a planer tool at an exactly specified depth below the skin, the results are not only incorrect but may be actually misleading. What value, then, have deductions made from combined carbon results except in a very general way? To be useful they should show a wider divergence than in the paper in question. That there is something amiss with some of the figures given is shown by adding up the combined carbon and graphite figures in Series A of the table, page 952. The metal poured hot has 3.25 total carbon, and after boiling the same iron has 3.60, which needs explanation. It is better in Series B.

The more extensive table, page 954, loses some of its value because of the unreliability of combined carbon determinations. The silicons can be grouped into three classes, by running a line between 1.18 and 1.36; and a line between 1.32 and 1.43. Mr. Stork admits that the results collected are from different days, and while they do bear out his contention that the chill decreased as the manganese went up, to the foundry metallurgist they must appear specially selected from a mass of material not by any means bearing out the point in detail. For instance, below 0.50 manganese it matters little for results whether this element is 10 or 20 points apart. The sulfur is not given, and this is highly important in connection with manganese and chill results. In

fact, picking out of the table three sets of figures, the following will be of interest:

| Silicon | Manganese | Combined Carbon | Chill, Inch |
|---------|-----------|-----------------|-------------|
| 1.18    | 0.29      | 1.47            | 0.80        |
| 1.35    | 0.35      | 1.32            | 0.75        |
| 1.43    | 0.34      | 1.49            | 0.75        |

For practical purposes, so far as these figures go, the chill is identical, the combined carbon is doubtful anyhow, and the manganese is about the same, yet the silicon, which can be determined with extreme accuracy, differs considerably. In regular practice there should have been a sufficient difference in chilling depth to correspond with the variation in silicon shown. All of which indicates that the table offers no particular proof on the effect of oxygen on cast iron.

In giving data on the slag situation in his melting practice, Mr. Stork, as already stated, only emphasizes the fact that this must have been defective in regard to the position of the bed, for when enough steel is burned to obviate the use of limestone in fairly long heats something is surely off.

On the whole, I am glad to see the paper published, as it affords a further opportunity to clarify a situation which most foundry metallurgists supposed had settled itself by going to sleep long ago.

### Differential Crystallization in a Cast-steel Runner

Discussion of the paper of F. B. FOLEY, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1117.

HENRY M. HOWE, Bedford Hills, N. Y. (written discussion\*).—Mr. Foley's explanation of this interesting occurrence is perfectly reasonable. Possibly a word explaining the phenomenon more in detail may not be amiss.

In the act of solidification each drop as it starts to solidify splits up into a half drop poorer in carbon and another half drop richer in carbon than the drop itself. The half drop poorer in carbon solidifies and attaches itself to the already solid walls, whereas the half drop richer in carbon remains molten for the excellent reason that it is richer and hence is more fusible than the original drop, and hence in turn is wholly fusible at the existing temperature.

Under usual conditions, as when the steel solidifies in a mold of any form, the successive molten half drops thus enriched in carbon remain present and by their enrichment progressively raise the carbon content of the remaining molten mass, out of which successive half drops are continuously solidifying and attaching themselves to the already solid walls. Because the molten mass thus becomes progressively richer

\* Received Aug. 8, 1919.

in carbon, each of the half drops which solidify from it in like manner is richer than the preceding one, because the carbon content of the particles which thus solidify increases with that of the molten mass out of which they solidify. Hence the familiar segregation, or progressive enrichment of carbon content from the skin or first freezing part of the mass to the matter just below the bottom of the pipe, which is the last freezing part.

But in the case of a runner this last condition is absent. Each molten half drop enriched in carbon and set free by the solidification of its mate poorer in carbon is immediately swept away by the swift stream gushing through the runner, so that every drop which starts to solidify is of the carbon content of the original molten mass in the ladle, and thus the progressive enrichment from drop to drop does not occur. Hence the existence of the low-carbon Widmannstättian band.

That the very outer band of all is much richer in carbon than this one is evidently due to a solidification of the very outer crust of the runner so rapidly, and in the form of pine trees out-shooting so quickly as to entangle and retain their molten higher-carbon mates formed by the act of solidification.

This principle which Mr. Foley points out is new, I believe, and may play a very important part in the phenomena of segregation in general. Thus it helps to explain the impoverishment of the lower deep-seated part of the ingot, from the axis outward for a considerable distance toward the skin. While this part is solidifying there is a rapidly rising molten current along the already solid walls, rising partly because its enrichment in carbon by the act of solidification makes it lighter than the average of the molten mass, and partly because of the entraining action of the gases which are now escaping from solution in effervescing steel. In fact, the formation of the Widmannstättian band may be grouped with this "negative segregation," so called, and so often noticed in the lower peri-axial part of steel ingots. It is segregation, though of a special type.

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### Effect of Time and Low Temperature on Physical Properties of Medium-carbon Steel

Discussion of the paper of G. A. REINHARDT and H. L. CUTLER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1091.

F. C. LANGENBERG,\* Watertown, Mass. (written discussion†).—I am inclined to the view that the change in physical properties encountered in the material with which the authors are working is due to the relief

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† Received Aug. 12, 1919.

of internal strains. The statement, on page 1098 of their paper, calling attention to the fact that this phenomenon disappeared when the material was rolled into  $1\frac{7}{8}$ -in. square billets is of particular interest. It is certain that the internal strains set up by cooling in a small billet of this size would be much less than those produced in a billet having a larger cross-section cooling under the same conditions.

The statement that the physical properties of a given test bar were materially changed by standing has been brought to my attention in connection with the testing of gun forgings. I have made a number of observations on forgings produced at Watertown Arsenal to ascertain whether any change in ductility was produced by the aging of the test specimens. The results were always negative, but this can be explained by the fact that a gun forging is generally a forging that has been quenched and subsequently drawn at a relatively high temperature.

In view of the fact that experimental methods for the determination of the resistance of internal strains are available, it would indeed be of the greatest interest if such work could be carried out on the material investigated by Mr. Reinhardt and Mr. Cutler. I think that the authors of this paper should be congratulated particularly in presenting in a concise and clear manner experimental work which proved beyond any reasonable doubt that test specimens may undergo a change in their physical properties upon standing. They have also proved, which is in my mind more important, that all test specimens will not undergo this change.

FRANCIS B. FOLEY,\* Washington, D. C. (written discussion†).—Reinhardt and Cutler have shown that test bars taken from certain blooms and broken immediately lack ductility, and that ductility is restored by rest at room temperature for a long time or by heating the bars for shorter periods of time. If these factors work to improve the ductility in the test bars, it is reasonable to suppose that they will also work in the same way to improve the metal in the blooms from which the tests were taken and that the time required for the restoration of ductility will increase with the size of the bloom, so that the smaller the section, the more rapidly this end will be brought about. Along this line of reasoning, we should expect ductility to be restored more quickly in the  $1\frac{7}{8}$ -in. square billets than in the larger blooms. This may in part account for the fact that this phenomenon of brittleness was not noted in the case of the  $1\frac{7}{8}$ -in. square billets but only in the larger blooms. Further, there is the matter of finishing temperature and rate of cooling after work was finished. The smaller sections cool more rapidly in the mill and therefore usually finish at a much lower temperature than the larger sections, and, cooling from a lower temperature, pass through their critical range at a slower

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\* Metallurgist, U. S. Bureau of Mines.

† Received Aug. 29, 1919.

rate than if the finishing temperature were high. To balance this there is the tendency to fast cooling due to the smaller section. It is possible, however, that the rate of cooling through the transformation, by preventing the complete separation of proeutectoid iron to the grain boundaries, may play a part in this brittleness. If the finishing temperature is low and the section small, a small grain size results and we may expect a small grain to give up its proeutectoid iron in a shorter space of time than a large grain. In this respect the small section is favored.

Strains probably also play a part in the production of this brittleness. Bars which show this brittleness (16 to 20 per cent. extension) after 4 days at 120° C., give from 22 to 25 per cent. after cooling in air from 850° C., showing that an air cool from 850° C. does not produce this brittleness in a test bar. Why then should it occur in the blooms? Perhaps because of finishing the blooms at a higher temperature than 850° C., or perhaps the condition may be due to strains set up in the cooling of the large section. There are many factors at work in the cooling of a large section from a high temperature. The grains in the center of the section are likely to be much larger than those near the outside; also, there is a temperature difference between the outside and inside which is probably exaggerated when the bloom starts to cool after finishing. By the time the material has reached its transformation range it is cooling quite rapidly; the outside starts to transform first and commences to lag while the center, still cooling, tends to approach it in temperature. The grains in the outside metal, being smaller than those in the inside, pass through their transformation range more rapidly and are further cooled more rapidly by the air, and so the outside metal soon begins extracting heat from the inside, thus cutting short its period of transformation. We may expect, therefore, a difference between the outside and the center with respect to temperature, grain size, and the arrangement of the microconstituents. These differences are exaggerated by rate of cooling, size of section, and finishing temperature. The size of the section is fixed; the finishing temperature and rate of cooling should be controlled if conditions of this kind are to be prevented. Finishing temperature can be kept low by controlling the temperature of the furnace in which the stock is heated. If the operation is to be a quick one, the temperature at which the work is started can be quite low, whereas if the time consumed in working is long, the starting temperature can be correspondingly higher, the same thing applying where the section is small and the material loses temperature rapidly in the course of the working.

### Determining Gases in Steel and the Deoxidation of Steel

Discussion of the paper of J. R. CAIN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1309.

ARTHUR F. BRAID,\* New York, N. Y. (written discussion†).—I have read Mr. Cain's paper with a very great deal of interest. The subject is one that is worth a great deal of thought and research at this time.

It is a well-known fact that the strong affinity of steel or iron for oxygen is perhaps the main detriment to sound production, and, as the author states, it is indeed remarkable that today there are no analytical methods in general use in steel works for determining the gaseous constituents of steel.

The research work now being carried out by the chemical metallurgical section of the Bureau of Standards on the deoxidation of steel is very interesting to me, and I had the pleasure of discussing this matter with Mr. Cain in Washington some time ago. I agree with the author, that the suitability of an alloy for deoxidizing purposes is based on the fusibility and viscosity or specific gravity of the oxides formed. The composition of the well-known 25 per cent. carbon-free ferrotitanium was no haphazard guess; the composition of this alloy is based on the fusibility and low specific gravity of the double oxide of titanium and aluminum that is formed when carbon-free ferrotitanium is added to steel.

### Graphitization of White Cast Iron upon Annealing

Discussion of the paper of P. D. MERICA and L. J. GUREVICH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1063.

H. A. SCHWARTZ,‡ Indianapolis, Ind. (written discussion§).—Referring to the very interesting paper on the graphitization of white cast iron, the writer desires to present certain facts and conclusions, entirely in harmony with those of the authors but which may be not without interest as furnishing additional evidence upon the same subject.

The graphitization of white cast iron, being the basis of malleable

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† Received Sept. 3, 1919.

‡ National Malleable Castings Co.

§ Received Sept. 4, 1919.

"annealing," has naturally been of very great interest to the National Malleable Castings Co., and has been the subject of investigation for some 12 or 15 years in the writer's laboratory. Our early work was somewhat erratic, but was given better direction by the published results of Dr. Storey, and after that date progressed easily and rapidly to what we regarded as a satisfactory conclusion. The latter and more successful part of our work consisted of determining, not the amount of graphite formed after exposure to a given temperature for a given time, but the time and concentration of combined carbon when equilibrium was attained at a given temperature. In general, a series of samples of uniform material of known composition would be held at a given constant temperature for various times, quenched and analyzed for total and graphitic carbon. The microscopic changes were also followed carefully. The exigencies of the available time and equipment did not permit of either the precision or completeness desirable if the results are to be applied to the construction of an equilibrium diagram for the stable system Fe-C, but the following conclusions are deemed to be justified by the observed facts.

Graphitization can be initiated at any temperature at or above a definite critical point. This point is very near the  $A_1$  point of the system  $\text{Fe}_3\text{C}$ ; it may possibly not be identical with it, but be found at a slightly lower temperature. A number of observers have reported the initiation of graphitization at temperatures slightly but decidedly below  $A_1$ . The writer has confirmed this observation, but there remains some doubt as to whether the divergence is due to errors of observation or is real.

The time to attain equilibrium, in a given alloy, is inversely as the temperature above the critical point, but varies with the chemical composition of the material and with its previous thermal history. Equilibrium when attained should correspond to  $EJ$  of the authors' paper. This line joins  $CO = T = \text{critical point}$ ; with the point  $E$  approximately  $C = 1.7$  per cent.,  $T = 1130^\circ \text{C.}$ , and the line is approximately, though not necessarily exactly, straight. We are more certain of its location toward the lower end than at temperatures above  $900^\circ \text{C.}$

Heating at any given temperature, indefinitely produces no increase in graphite content at the expense of combined carbon after the combined carbon has dropped to a concentration corresponding to equilibrium at the temperature used. The microstructure then corresponds to a homogeneous mix crystal matrix through which is scattered free carbon. On cooling such material to a lower temperature, the structure and composition may be made to conform to that in equilibrium with free carbon at each succeeding lower temperature by sufficiently retarding the rate of cooling. In general, cooling must vary with the elevation of temperature above the critical point, being, in theory, infinitely slow when  $A_1$  is nearly reached. Even at fairly high temperatures rates of  $5^\circ \text{C.}$

an hour are rather fast. It is, therefore, very difficult to actually attain the equilibrium condition at relatively low temperatures. At temperatures at or below the critical point the equilibrium condition is that in which only ferrite and temper carbon exist, as in malleable cast iron; this state, however, is not reached unless cooling is slow. Cooling to  $A_1$  too rapidly to permit the alloy to reach equilibrium at each successive temperature during cooling permits the alloy to reach  $A_1$  while still containing more or less considerable amounts of carbon in the "combined" state. At  $A_1$  such alloys allow the mix crystal to be converted into pearlite and form structures exactly similar to the authors' Figs. 3 to 6, temper carbon surrounded by ferrite with a background of pearlite.

The very slow initiation and progress of graphitization at low temperatures is clearly shown by the comparison of the  $700^\circ$  points in the 6-hr. and 48-hr. branches of the curve in Fig. 1. The more rapid progress is shown in the  $800^\circ$  points. At  $900^\circ$  and  $1000^\circ$ , equilibrium being nearly approached even in 6 hr., the increased graphitization with additional times is not marked.

The reason for the apparent anomaly referred to in the last paragraph of page 1070 is, in the writer's opinion, capable of explanation on the following assumptions, which are identical with the authors' explanation in reasoning, but differ in the wording. The time of heating, being the same for  $1000^\circ$  and  $1100^\circ$  and sufficient to attain equilibrium at  $1000^\circ$ , was also necessarily sufficient to leave the metal in equilibrium at  $1100^\circ$ . The metal at  $1100^\circ$  contains more combined carbon than that at  $1000^\circ$ , since carbon is more soluble at the higher temperature, indicated by the direction of  $BJ$ . Cooling was more rapid than is consistent with the maintenance of equilibrium with descending temperature, therefore the sample heated at  $1100^\circ$  when it reaches  $1000^\circ$  has more combined carbon than the sample held at  $1000^\circ$  until equilibrium was attained. Both samples cooling from  $1000^\circ$  at the same rather rapid rate, the sample which at  $1000^\circ$  had the highest combined carbon will also arrive at  $A_1$  with the highest carbon and will therefore contain more pearlite than its mate. The same phenomenon is not noted at lower pairs of temperature, since in those cases initial equilibrium was not attained.

The authors' conclusion that the eutectoid point for the system Fe-C is much lower than Guertler's figure, 0.70 per cent., cannot be successfully attacked. Aside from research experiments, there is the evidence of the entire tonnage of malleable castings which represent the end point of the graphitizing reaction and in which the combined carbon is seldom above 0.10 per cent. Data such as Guertler's are frequently based on the apparent termination of the graphitizing reaction during the freezing of gray iron coupled with an inadequate appreciation of the fact that graphitization occurs in two distinct stages.

The mechanism by which the graphitization of white cast iron is accomplished seems not to be clearly understood as yet. There seems to be a general acceptance of the fact that the presence of primary cementite is a requisite to the initiation of graphitization. This conclusion is pretty well supported by the fact that a carbon content much below 2 per cent. either prevents or retards graphitization very materially. Furthermore, it has been observed that alloys of such carbon content as to be non-eutectiferous but hypereutectoid, *i.e.*, approximately between 0.9 per cent. carbon and 1.7 per cent. carbon, may graphitize better at low temperatures, when they fall to the right of *SE*, than at higher temperature, when they are to the left of that line and hence contain no free cementite. This thought, however, would require that graphitization should terminate at any given temperature at a (combined) carbon concentration corresponding to the intersection of the line *ES* with that temperature. Dr. Merica's observations indicate that this is not the case, the graphitization terminating at points on the line *BJ* to the left of *ES* proving that graphitization continues after the destruction of cementite is complete. The fact that graphitization proceeds at measurable rates under conditions at which it cannot be readily initiated is explained by the effect of the presence of carbon nuclei. The fact that *BJ* has been determined in our laboratories as intersecting the line *CO* very close to the  $A_1$  point and that it is approximately straight indicates apparently conclusively that the reaction is completed by the graphitization of the mix crystal.

The straightness and location of *BJ* preclude the thought that graphitization extends only to the destruction of free cementite and that graphitization if complete terminates necessarily by the graphitization of the cementite of pearlite below  $A_1$ . This supposition would give as the locus of *BJ* the line *ES* followed by a line joining *S* with the critical point of the stable system, *CO*, temperature slightly under  $A_1$ . There seems some evidence, however, in the data of the writer confirmed by observations by Touceda, that upon reheating the completely graphitized product no recombination of free carbon occurs till  $A_{r1}$  is passed and then the concentration of combined carbon is of the eutectoid ratio. The equilibrium in that case, however, is then no longer than that of the stable system, but of the metastable system  $Fe_3C$ .

The writer is very strongly convinced that the line *BJ* now regarded as not well established in location by most writers should be provisionally drawn as a straight line to intersect *CO* at about 680° C. A very accurate determination of its location would be extremely interesting and might slightly alter its form and location.

In the freezing of gray iron it is true that graphitization ends at concentrations of combined carbon of the general order of magnitude of the carbon in the eutectoid (pearlite). This seems to be due to the fact

that the time at higher temperatures has been such as to permit the complete destruction of cementite but the cooling has been too rapid to permit of much graphitization in the mix crystal.

### The Wisconsin Zinc District

Discussion of the paper of W. F. BOERICKE and T. H. GARNETT, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1213.

J. H. POLHEMUS, New York, N. Y. (written discussion\*).—The Joplin mining and milling practice has largely influenced operating methods in the Wisconsin district. Milling equipment is essentially of the same type with the notable exception that no tables are used. The treatment of the fine sands has been attempted several times but without commercial success. Table material coming from any one mill is low both in tonnage and zinc content. The iron is comparatively high as the pyrite-lime "chat" is much more prevalent than the zinc-lime attached particle. In the finer sizes the zinc occurs mainly as free mineral. These conditions make the production of good-grade table concentrates very difficult. The accompanying tabulated results from several mill tests indicate the character of the mill tails. I think the average mill tails in the district assay nearer 1.5 per cent. zinc than under 1 per cent., as stated by Messrs. Boericke and Garnett.

| Mesh              | Mill No. 1                |                      |                      | Mill No. 2                |                      |                      | Mill No. 3                |                      |                      |
|-------------------|---------------------------|----------------------|----------------------|---------------------------|----------------------|----------------------|---------------------------|----------------------|----------------------|
|                   | Per Cent.<br>by<br>Weight | Zinc<br>Per<br>Cent. | Iron<br>Per<br>Cent. | Per Cent.<br>by<br>Weight | Zinc<br>Per<br>Cent. | Iron<br>Per<br>Cent. | Per Cent.<br>by<br>Weight | Zinc<br>Per<br>Cent. | Iron<br>Per<br>Cent. |
| On 10.....        | 42.4                      | 0.7                  | 5.3                  | 73.4                      | 0.9                  | 2.9                  | 66.0                      | 1.7                  | 4.4                  |
| — 10 + 20.....    | 20.2                      | 1.3                  | 5.2                  | 7.7                       | 1.5                  | 3.8                  | 15.3                      | 1.9                  | 4.5                  |
| — 20 + 40.....    | 9.6                       | 1.7                  | 4.9                  | 3.7                       | 1.5                  | 3.5                  | 6.8                       | 1.9                  | 3.6                  |
| — 40 + 80.....    | 8.3                       | 1.5                  | 4.4                  | 3.8                       | 1.9                  | 3.1                  | 4.0                       | 2.4                  | 3.1                  |
| — 80.....         | 19.5                      | 2.5                  | 6.2                  | 11.4                      | 4.2                  | 6.4                  | 7.9                       | 3.5                  | 5.2                  |
| Total.....        | 100.0                     | 1.31                 | 5.3                  | 100.0                     | 1.32                 | 4.13                 | 100.0                     | 1.91                 | 4.37                 |
| Feed to mill..... |                           | 4.7                  | 6.7                  |                           | 6.3                  | 3.8                  |                           | 6.5                  | 7.5                  |

The fines offer a more promising field for increased recoveries than do the table sizes. Flotation tests have been made with very promising results. High recoveries and good-grade concentrates are indicated, the pyrite and marcasite largely remaining in the tails. The general mill practice now is to make as little fines as possible, keeping the feed

\*Received Sept. 4, 1919.

to the jigs as coarse as will produce concentrates fairly low in lime. Very little regrinding is done, the coarser middlings from the rougher jig being the main product so treated. This practice often results in concentrates carrying comparatively high lime contents, the lime being present as attached particles and very fine sand or fines. If flotation could be adapted more regrinding could be done and the fines classified out of the jig feed. This would result in better grade concentrates and increased recoveries, as the fine mineral being lost under present mill practice would largely be recovered.

The majority of the mines still stick to hoisting in buckets as in the Joplin district with the hoist placed in the top of the derrick. The tendency, however, is toward the use of cars and cages, as described by the authors, as the cars are better adapted to power and mule haulage and the use of power shovels underground. The haulage problem has not received the attention it deserves, but rising labor costs and lengthened hauls will probably lead to the discard of the mule in the near future in favor of the locomotive. With proper tracks, the ton-mile figure of 25 to 30 c. given by the authors should be almost cut in two. The scarcity of shovelers has led to the trying out of several types of underground shoveling machines. The successful use of such machines is intimately tied up with the installation of a good transportation system and a well defined mining plan. If the capacity of the shovel is held down by inability to keep enough "empties" on hand or if the shovel has to be constantly moved to be supplied with ore, there is little chance for success. A fairly accurate knowledge of the orebody, as obtained by drilling, is of material assistance in laying out the mining work. Obtaining this knowledge by the actual mining out of the ore adds to one's hindsight, but a little foresight is worth a lot of the other. Drilling will show where the mine bottom will be, thereby doing away with much "taking up of bottom," whether or not the stopes will be of sufficient height and size to warrant consideration of power shoveling, whether sublevel work will be most advantageous, and whether cheaper mining methods may not be possible. The inherent irregularities in the orebodies make any knowledge gained by drilling very valuable in preventing irregularities of operation.

In certain orebodies where mineable ground from 50 to 80 ft. (15 to 24 m.) high is found, and where the ground stands well, other mining methods than those now being used should be seriously considered. If the mine is not so wet as to cause cementing of the broken ore, shrinkage stoping might be successfully applied. The necessary drifts and raises would be largely in ore and the dead work expense consequently low.

The points touched on here are not new but merely emphasize certain possibilities for lowering costs and improving recoveries.

### Magnesite: Its Geology, Products and Their Uses

Discussion of the paper of C. D. DOLMAN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1193.

A. MALINOVSKY,\* Belleville, Ill. (written discussion†).—I have been very much interested in Mr. Dolman's paper. We all realize, I think, that this question of developing our home industries and supporting the new industries which have developed during the great war is very important at present.

Mr. Dolman has well shown the quantity and quality of the raw magnesite in the United States, and the commercial and industrial possibility of our home magnesite and I believe, with him, that our home industries should receive adequate protection. There are two reasons, however, for believing that this may be difficult.

One reason is that much American capital is invested in the Austro-Hungarian magnesite industry. The raw magnesite can be quarried and prepared for the market in Austria with much cheaper labor expense than in the United States; large deposits which are very easy to quarry and good transportation facilities also contribute to the cheapness of production.

The second reason is the old saying that the magnesite found in the United States is not of the same quality as the Austro-Hungarian magnesite; this I doubt. Even if the magnesite found here does not in a raw state equal the Austro-Hungarian, it can be synthetized so that the finished article will have the same properties as the Austro-Hungarian finished magnesite refractory possesses. Raw magnesite from Greece is not the same as the Austro-Hungarian, but it has been demonstrated that a good refractory can be made from the Greek product.

The first reason can be overcome by the loyalty to the United States of the men who are interested in the foreign magnesite industry. Their choice should be not to develop foreign industries and a home market, thus depressing the home industries, but to develop the home industries and a foreign market, and thus help to build up our commerce with other nations. The United States leads in iron, steel and copper production, and therefore an enormous quantity of magnesite refractory will be consumed at home in many different industries for many years to come.

The answer to the second reason is that the well known Veitsch Magnesite Co., in Austria, has not won its name and place in the world market by the purity or special property of the raw magnesite, as many

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\* Chemical Engineer, The Malinite Co.

† Received Sept. 3, 1919.

in the United States believe. The Austrian raw magnesite varies considerably in siderite (chalybite) whereas the marketed finished product is very uniform. The Austro-Hungarian magnesite refractory product has succeeded in conquering the world market by a high standard uniformity, by skilful technical management, by careful sorting, by calcining at high temperature, by careful grinding and sizing the high calcined product, by making into brick under a high pressure, by careful drying and then burning at a high temperature.

If the American raw magnesite is carefully sorted, dressed and mixed with the iron ore, and then calcined to a high prolonged temperature, carefully ground to the required size of grains, pressed under a high pressure, then carefully dried and burned at high temperature, a first class product can be obtained, equal to any magnesite refractory produced abroad. Homogeneous condition and good conversion of the magnesite to periclase by high temperature is of the greatest importance. After the raw magnesite is carefully sorted and mixed, it should be calcined to a high temperature (about 1500° C. or better) since this is the important factor in transforming magnesite into a dense crystalline product of periclase; and a good quality of magnesite refractory brick should consist of a high percentage of periclase.

By this process of high calcination and conversion of the caustic magnesite to periclase, the maximum volume shrinkage is obtained, so that after grinding and careful sizing of the grains, the additional shrinkage in the final burning of the brick will be very small, and there will be no further shrinkage after the brick is placed in use in the furnace wall and kept in continuous furnace condition.

It is very important to standardize the finished product as the weakest point of most refractories is excessive shrinkage when in use, which leaves great spaces at the joints and causes the brick to give way.

The binder, which is also a very important factor, should be carefully selected and tested to determine the kind of binder to be used and the amount needed to give the best and most satisfactory result. The mortar in which the magnesite brick is laid in the furnace wall is just as important as the brick itself. Therefore care should be given to see that this material is as carefully prepared as the material for the brick.

After all, the aim of the American magnesite refractory makers should be to produce a uniform standard quality, so that the users of basic refractories can rely on the quality and get accustomed to it. This can be attained by skilled technical management at every stage in the manufacturing process, from the quarry to the final burning and cooling.

### Height of Gas Cap in Safety Lamp

Discussion of the paper of C. M. YOUNG, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1207.

E. B. WILSON, Scranton, Pa. (written discussion\*).—Prof. Young's paper shows another application of electricity in solving problems in coal mining, and suggests that it may be possible to utilize the data he has collected in developing an electric firedamp detector.

If electric lamps are to be adopted in gassy coal mines, the use of an electric firedamp detector becomes almost imperative, for safety lamps and electric lamps in the same mine are not always conducive to safety, and Liveings electric firedamp detector, is too cumbersome to meet with general approval.

Three well understood facts are verified in a new way by Prof. Young's experiments:

1. The temperature at which methane ignites.
2. The more inflammable gas present in an atmosphere, the hotter will be the flame, and the longer the cap in a safety lamp.
3. As the temperature at the source of ignition varies, the length of the gas-cap flame varies.

Prof. H. B. Dixon collaborating with Mr. H. F. Coward, some years ago, made experiments on the ignition of various gases to find the temperature of their kindling points.<sup>1</sup> From the results of their experiments, the writer has culled the ignition temperatures of some hydrocarbon gases, and has tabulated them with other data, in Table 1.

TABLE 1.—*Ignition Temperatures of Hydrocarbon Gases Met with in Mines, together with their Heat Units*

| Gas            | Formula  | Ratio $\frac{C}{H}$ | Temperature of Ignition Degrees C. | B.t.u. per Cubic Foot |
|----------------|----------|---------------------|------------------------------------|-----------------------|
| Acetylene..... | $C_2H_2$ | 1 : 1               | 406–440                            | 1,555                 |
| Ethene.....    | $C_2H_4$ | 1 : 2               | 500–519                            | 1,673                 |
| Ethane.....    | $C_2H_6$ | 1 : 3               | 520–630                            | 1,858                 |
| Methane.....   | $CH_4$   | 1 : 4               | 650–750                            | 1,065                 |
| Hydrogen.....  | H        |                     | 580–590                            | 348                   |

It will be noticed that the less carbon and the more hydrogen a gas contains the higher will be its temperature of ignition, also that the density of a gas has a direct bearing on the number of heat units evolved by its combustion.

\* Received Aug. 25, 1919.

<sup>1</sup> *Jnl. Chem. Soc., Trans.* (1909) 95, 814.

Evidently the wide range between the first and second temperatures is due to the varying conditions accompanying the tests, therefore it appears that Young's curves are quite uniform within the possibilities of temperature differences, even assuming that the composition of the gas varied slightly. It is possible that the nearly horizontal extension of Prof. Young's curves, while the temperatures of the gases were below 800°, was due to the molecules having reached a distance from the source of heat where vibrations failed to increase, and thus limited the transmission of heat, but as the heat intensity increased the vibrations increased sufficiently to extend the flame.

This speculation is based on the assumption that gas, like any other substance, must be raised to the temperature of ignition before it will burn. This being true, then the cap flame which originated at the point of ignition is extended by those molecules of gas burning which have never been in direct contact with the source of heat.

Mr. Force, chief chemist of the Delaware, Lackawanna, & Western R. R., recently made experiments in which mine air containing a small percentage of methane was used under boiler furnaces. He found that so small a quantity as 1 per cent. of methane was able to replace a certain amount of coal for steam raising. If, then, 1 per cent. gas furnished a certain amount of heat, it is reasonable to suppose that 2-per cent. gas would furnish double the amount. Prof. Young's graph follows this line of reasoning when the difference in the mixture of gas is 1 per cent., but when the gas is doubled from 2 to 4 per cent. the height of the flame is trebled, thus showing that the heat conditions about the point of ignition are materially changed.

This offers an explanation why the same lamp with different illuminants gives different heights of caps, and why different types of lamps with the same illuminants give different heights of caps; also why the same types of lamps with the same illuminants give slightly different caps.

An interesting proof of the mechanical mixture of gases is developed by the safety lamp, which under certain conditions will show caps in an atmosphere that contains but  $\frac{1}{250}$  part of gas. It would be unreasonable to expect that an atmosphere containing but one part of inflammable gas in two hundred and fifty parts would produce and transmit as much heat as another volume of air that contained one part of gas in one hundred parts, or one part of gas in fifty parts, etc. Evidently, then, the height of the gas cap is not entirely due to the heat at the point of ignition, and some credit must be given to the extension of the flame through the combustion of the gaseous molecules. Liveings firedamp indicator is based on the comparative brightness of two glowing platinum wires, one enclosed in an airtight vessel and the other exposed to the atmosphere to be tested. Firedamp coming in contact with the exposed

red-hot platinum wire raises its temperature, and causes it to glow more brightly. The greater amount of firedamp present, the greater the heat of combustion and the brighter the glow. It is possible that the trebled length of cap flame appearing in Prof. Young's graph is due to the increase of sensible heat which is measured by the thermophile and the combustion of the molecules of gas which have never been in touch with the coil. The sensitiveness of the experimental apparatus is not equal to that of the tri-burner Ashworth lamp, or to the Pieler lamp using alcohol for the initial flame. The former lamp gives a 3-in. flame when 1 per cent. of gas is present; the Pieler lamp furnishes a flame over 3 in. long with 1 per cent. gas, and over 5 in. long with 2 per cent. gas in the atmosphere. Since the platinum metals seem to have an affinity for hydrogen, the use of platinum sponge rather than platinum wire would increase the sensitiveness of the apparatus.

James Ashworth<sup>2</sup> gives the following order of sensitiveness for the fluids used in safety lamps:

1. Benzine, benzolene, colzalene, and naphtha.
2. Petroleum and paraffin.
3. Mixtures of vegetable or fish oils with petroleum.
4. Vegetable and fish oils.

As a broad rule, the nearer a substance is to the gaseous condition, the higher the temperature to which it must be exposed before kindling. Ignition temperatures of some oils are: petroleum, 380° C.; gas oil, 350° C.; benzine, 415° C.; benzole, 520° C.; tar oil, 580° C. (The latter is presumed to be the drip oil from illuminating gas.)

In the same article, Ashworth demonstrated that the larger the lamp flame the longer would be the cap for a given percentage of gas and also that the larger the lamp flame, the more heat is produced. The difference in the heat of the testing flame is shown in three separate sets of caps in a height of 3 in. This was accomplished by altering the height of the flame in an Ashworth-Clowes hydrogen-gas testing lamp, and thus changing the temperature at the source of ignition.

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### Commerical Recovery of Pyrite from Coal

Discussion of the paper of S. H. DAVIS, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1469.

EDWARD HART,\* Easton, Pa. (written discussion†).—In 1895 I visited the chemical plant of the Messrs. Chance at Oldbury, England, under the guidance of Mr. France, the manager. In the stock house I saw a

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\* *Iron & Coal Tr. Rev.* (1906) **72**, 293, 375.

\* Professor of Chemical Engineering, Lafayette College.

† Received Aug. 13. 1919.

pile of coal brasses with adhering coal and said to Mr. France, "I should think you would get dark acid." "Yes," he replied, "our acid has always been rather black and our customers have grown used to it. Some time ago we ran out of brasses and could get only Spanish pyrite. Our product became white and the customers began to complain, so I put a little sugar in each carboy."

E. A. HOLBROOK,\* Pittsburgh, Pa. (written discussion†).—Mr. Davis says, "A very large tonnage of pyrite is annually being thrown in the waste in the coal mines of this country." This quantity is much larger than is generally realized by people not intimately associated with coal mining. At the beginning of the war this country seemed threatened with a shortage of pyrite. The U. S. Bureau of Mines conducted a general investigation of the pyrite resources of the country in order to ascertain what material was commercially available. The general pyrite investigation was in charge of H. A. Buehler, with the subsection on coal pyrite in charge of E. A. Holbrook.

In May, a conference of State Geologists, the Bureau of Mines, and a representative of the U. S. Geological Survey, was held at Urbana. Those present included Messrs. Buehler and Holbrook of the Bureau, P. M. Smith of the U. S. Geological Survey, and representatives from the State Geological Surveys of Iowa, Missouri, Tennessee, Illinois, Indiana, Ohio, West Virginia, and Pennsylvania. It was decided that each State Survey should send out a field man in its own state and that he should visit, so far as possible, each bituminous coal mine in his state; he should actually go to the working faces underground and there, by measurement, make an estimate of the amount of pyrite available through the mining of the coal. The conference visited a coal mine near Danville, Ill., and while there adopted a common method of sampling and estimating the pyrite. Briefly, several sections were to be measured underground at the face of each mine. The average thickness of pyrite in the seam was to be noted and multiplied by three. Thus the assumption was made that the pyrite was three times as heavy as the coal, a very close approximation. If for any reason estimations of pyrite had to be made from amounts already mined, proper allowance should be made for coal adhering to pure pyrite nodules. A standard report form was adopted.

The Bureau of Mines agreed to keep a chemist at Urbana to whom the various State Geological Survey field men might frequently send samples of pyrite for sulfur analysis, to determine uniformly the grade of the various coal pyrite occurrences. It was arranged that Mr. Holbrook should visit each of the working field men and cooperate wherever possible

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\* Superintendent of Pittsburgh Station, U. S. Bureau of Mines.

† Published by permission of the Director of the Bureau of Mines. Received Aug. 30, 1919.

in securing uniformity of work and quick results. The Bureau also agreed to run mill tests on ton lots of crude coal pyrite which might be submitted in anticipation of a commercial plant working on the specific pyrite tested. A list of the tests run by the Bureau on this work is given here.

LIST OF COAL PYRITE TESTS MADE AND REPORTED ON BY MIDDLE  
WEST STATION, U. S. BUREAU OF MINES, FEB. 1-NOV. 1, 1918

|   | TESTS |
|---|-------|
| 1. Picking belt refuse from Middle Forks Mine, Benton, Ill.....           | 5     |
| 2. Washery refuse from Middle Forks Mine, Benton, Ill.....                | 3     |
| 3. Washery refuse from Gillespie, Ill.....                                | 2     |
| 4. Crude coal pyrite from No. 3 seam, Indiana.....                        | 2     |
| 5. Crude coal pyrite from No. 5 seam, Indiana.....                        |       |
| 6. Crude coal pyrite from No. 6 seam, Indiana.....                        |       |
| 7. Crude coal pyrite from Earlington, West Kentucky.....                  |       |
| 8. Washery refuse from Earlington, West Kentucky.....                     |       |
| 9. Washery refuse, Southern Coal & Coke Co., East St. Louis, Ill.....     |       |
| 10. Crude coal pyrite from Mulberry, Kans.....                            |       |
| 11. Washery refuse, Keota, Missouri.....                                  |       |
| 12. Crude coal pyrite from New Philadelphia, Ohio.....                    | 2     |
| 13. Crude coal pyrite from Mines of Bon Air Coal and Coke Corporation.... |       |
| 14. Bon Air, Tennessee.....   |       |
| 15. Washery refuse from Saginaw, Michigan.....                            |       |
| 16. Crude coal pyrite from Sunfield, Illinois.....                        |       |
| 17. Washery refuse from Tyler, Pa.....                                    | 2     |
| 18. Crude coal pyrite from Winburne, Pa.....                              |       |

About 70 per cent. of these tests were successful and indicated that a commercial grade of pyrite could be easily concentrated and recovered from the crude material submitted.

During the summer, H. F. Yancey, assistant chemist at the Urbana station, analyzed for sulfur several hundred samples of pyrite submitted by the field men; many of these samples were also analyzed for arsenic, carbon, and phosphorus. Results of this chemical work have been compiled and will shortly appear as an article in the technical press. The results of the general tests at Urbana just noted have in each case been sent to the men interested, and at present are being worked into a bulletin on this subject which will be accompanied by the detailed summary and estimates of the work of the field men from each state. In addition to the states already noted, some work was done by the Bureau in the Kansas, Michigan, and Kentucky coal fields. The State of West Virginia did not coöperate because the Consolidated Coal Co. of Fairmont, W. Va., had already gathered statistics on coal pyrite in that state and had erected a sulfuric-acid plant at Fairmont for coal-pyrite utilization. Consequently, we have no knowledge of the quantity or purity of the coal pyrite in West Virginia.

Following is a summary of the estimated possible early production of

coal pyrite in all of the principal coal-mining states of the East. This summary is based only on pyrite that can be recovered with purity in sulfur of more than 40 per cent., and including only mines that could produce 1 per cent. or more of their coal production as coal pyrite. It would be fair to assume that this production could be obtained provided a price of 20 c. per unit on a basis of 40 per cent. sulfur could be made for this material f.o.b. at the mines.

| TONS PER YEAR                               |         | TONS PER YEAR                   |         |
|---|---------|---------------------------------|---------|
| 1. Kansas.....                              | 125,000 | 6. Kentucky.....                | 25,000  |
| 2. Missouri.....                            | 175,000 | 7. Tennessee.....               | 56,000  |
| 3. Iowa.....                                | 140,000 | 8. Michigan.....                | 12,000  |
| 4. Illinois.....                            | 238,000 | 9. Ohio.....                    | 235,000 |
| 5. Indiana.....                             | 250,000 | 10. Pennsylvania.....           | 200,000 |
| Total possible for Eastern coal fields..... |         | 1,456,000 tons pyrite per year. |         |

While the early close of the war and the unexpected developments of the sulfur fields of Louisiana and Texas stopped any general progress toward the utilization of this vast yearly possible supply, the knowledge that it is available at any time of future need makes this country independent of foreign sources of pyrite.

### Low-sulfur Coal in Pennsylvania

Discussion of paper of H. M. and T. M. CHANCE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1459.

RICHARD R. HICE, Beaver, Pa. (written discussion\*).—The matter of selective mining is probably of more importance in Pennsylvania than is washing, and perhaps washing would not be necessary at some plants where now practised if proper care were taken in the mining. I have in mind one plant where the sulfur content of the entire bed is more than 2 per cent., yet if the bottom 12 in. and the top 12 or 15 in. are separated, the main portion of the bed, some 6 ft., will not contain more than 1.25 per cent. sulfur; and yet in this mine the entire bed is worked together, the resultant coke, as a matter of course, not being fit for use in iron smelting.

Not sufficient notice is taken of the "Double-thick" Upper Freeport coal in Allegheny and Butler counties. This is a very valuable deposit. Other areas where there is a top member of the Upper Freeport coal are also known, which add to the value of this bed as a coking coal. This double Freeport coal is especially suited for byproduct coking.

I cannot be as optimistic as regards the "low-sulfur" Pittsburgh coal in Greene county as the authors. If the term low-sulfur is to be confined to coal with not exceeding 1.25 per cent. sulfur, there is probably little

\* Received Aug. 26, 1919.

of Greene county that will come under the classification. The mines now working in the county, the records of drill holes in this county and in adjoining areas of Washington county and West Virginia, do not indicate that there will be much coal in Greene county that can be classed as low-sulfur. Western and southern Washington county, from the relatively little data available, must be largely classed as carrying at least more than 1.25 per cent. sulfur. In some cases the sulfur content can be reduced by washing, but in others the reduction in sulfur will not justify the expense.

The authors have brought into a concise statement the substance of a mass of literature on Pennsylvania coals, which certainly is of value both to the coal industry and to the consumer who wants a fuel suited to his needs.

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### Mill Operations at United Eastern during 1917 and 1918

Discussion of the paper of W. O. NORTH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1171.

LUTHER B. EAMES, Pueblo, Colo. (written discussion\*).—In reading Mr. North's interesting paper, several points have been noted that appear to warrant discussion. With a feed all through 20 mesh, I feel inclined to question the use of steel balls as large as 2 in. in a tube mill. I have seen balls as small as  $\frac{3}{4}$  in. used for the dry grinding of cement clinker, and surely many more points of contact would result from smaller balls. This would seem to be desirable in a mill as short as 6 ft. The heavy load in the classifiers would also indicate a high proportion of returned pulp. I hope that some discussion by Mr. North and others may develop this point.

The flow sheet on page 1181 shows the solution returning from the dam valued at 40 c. per ton being added to the last decantation tank. Theoretically, this solution should not be added to that of a lower value. As I calculate it, if this solution were added to tank X the solution finally discharged from tank Z would be reduced in value by nearly 4 c. per ton.

I think Mr. North's explanation of the difference between the actual and the theoretical columns in Table 10 is undoubtedly correct; namely, that dissolving is still taking place very rapidly in the underflow of tank U. It has occurred to me that with so finely ground a pulp as this, it might be possible to connect two of the seven agitators in between the Callow cones and tank U. This would require these two tanks to handle a very thin pulp but would, if successful, tend toward a much closer resemblance between the actual and theoretical columns. It would also give the remaining five agitators the advantage of doing their work in a lower grade of solution.

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\*Received Aug. 20, 1919.

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## Book Review

**MANAGEMENT AND MEN.** By Meyer Bloomfield, Boston. The Century Co., New York, 1919, pp. 584, H.X. 5½. \$3.50.

This book is an exposition of English efforts to solve the problem of labor unrest in England. The first six chapters are reprinted from articles published in the *Saturday Evening Post*, for whom the author went to England to study the problem at first hand. These articles deal with housing, increased production, eliminating the internal friction in the industrial machine and a chapter each devoted to the viewpoint of employer and employee. These chapters are written in the easily readable magazine style and give a complete general survey of the particular solution being tried. Perhaps their greatest, certainly not their least, worth lies in the fact that they form a vehicle for unusually voluminous appendices containing in full the famous Whitley Reports which are the basis of the new movement, together with various reports, which, except for this publication, would be largely inaccessible to those interested in this country.

The Whitley scheme considers each industry a unit and proposes to establish therein a Joint Standing Industrial Council composed of representatives of employers and employees to consider appropriate matters affecting the industry at large. There is to be a District Council for each industry which will, as its name implies, deal with the matters pertaining to that interest in the particular district. The third and last body in this scheme of Industrial Parliament is the Works Committee, which is composed of representatives of the management and of the workers employed in particular plants or mines to act in close coöperation with the district and national machinery.

The Whitley or similar schemes have been tried in many communities in England and the book contains interesting comments on the result obtained, it being notable that most of the objections come from plants which have not tried the scheme.

Meyer Bloomfield, the author, is the specialist in industrial personnel problems who organized the industrial service activities of the United States Shipping Board, Emergency Fleet Corporation.

P. E. B.

## Book Notices

**BOILER FEED WATER.** A Concise Handbook of Water for Boiler Feeding Purposes (Its Effects, Treatment, and Analysis). By Percy G. Jackson. Lond., Charles Griffin & Co., Ltd.; Philadelphia, J. B. Lippincott & Co., 1919. 102 pp., 7 × 5 in., cloth, \$2. (Gift of J. B. Lippincott Co.)

**CONTENTS:** Mineral Constituents, Corrosion, Softening, Selection of Softening Plates, Priming, Scale, Grease, and Overheating, Methods of Analysis, Analysis of Scale, Control Tests for Water Softening, Sampling, Solutions. Appendix: List of Factors, List of Atomic Weights, Clark's Table of Hardnesses.

Intended to be a reliable, concise and practical compendium of information on boiler waters and feed water troubles. It is based on long experience as chemist to an English boiler insurance company.

**MANUAL OF THE CHEMICAL ANALYSIS OF ROCKS.** By Henry S. Washington. 3d edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 12 + 271 pp., 1 pl., tables, 9 × 6 in., cloth. \$2.50.

The object is to present a selection of methods for the analysis of silicate rocks,

especially those of igneous origin, adapted to the needs of chemists, mining engineers, etc., who have not made a particular study of quantitative analysis.

The present edition has been thoroughly revised and considerably enlarged.

**MECHANICAL DRAWING FOR HIGH SCHOOLS.** A Text with Problem Layouts. By Thomas E. French and Carl L. Svensen. 1st edition. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 221 pp., illus., tables, 9 × 6 in., cloth.

The object is to present mechanical drawing as a definite educational subject by which the student's power of visualization may be developed and his constructive imagination strengthened, while he is also taught to think exactly, to understand and make mechanical drawings and to know modern drafting-room practice.

The course outlined covers two years' work and is a complete textbook and book of problems.

**TEXT-BOOK OF HEAT ENGINES.** By Andrew Jamieson. Vol. 1. 18th edition. Revised by Ewart S. Andrews. Lond., Charles Griffin & Co., Ltd., 1919. 551 pp., 8 × 5 in., cloth, \$3. (Gift of J. B. Lippincott Co.)

A revised edition of Prof. Jamieson's "Textbook on Steam and Steam Engines," with the omission of the chapters on steam turbines and boilers. The omitted chapters, with others on thermodynamics, entropy and internal combustion engines, will appear in volume two.

### Accessions

**AIDE-MEMOIRE DE L'INGÉNIEUR.** 2 vols. Laharpe. 19th edit. Paris.

**ATOMIC AND MOLECULAR WEIGHTS AND FACTORS USED IN CERAMIC CALCULATIONS.** Publ. by The Harshaw Fuller & Goodwin Co. (Gift of Robert D. Landrum.)

**BRASSFOUNDING.** By Joseph G. Horner. 1918. London.

**BIBLIOTHECA CHEMICA.** By John Ferguson, comp. 2 vols. Glasgow. 1906.

**COURS DE GÉOMÉTRIE PURE ET APPLIQUÉE.** Vol. 1. Transformations géométriques. By Maurice D. Ocagni.

**ELEMENTS OF METALLURGY.** By J. Arthur Phillips. London. 1874.

**ESSAI D'UNE THÉORIE DES FOURS À FLAMMES.** Trans. from Russian by Léon Diquatch and A. Rothstein. Paris. 1914.

**HYDRO-ELECTRIC POWER COMMISSION OF THE PROVINCE OF ONTARIO.** 11th Annual Report. 1918. Vol. 1. (Gift of Commission.)

**INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.** 14th Annual Issue D. Chemistry. London. 1919.

**L'INDUSTRIE ALLEMANDE ET LA GUERRE.** By R. C. P. Jauréguy, H. B. Fromont and R. E. Stephen. Paris. 1918.

**LATIN AMERICA: Trade Chart of Latin America.** Publ. by Irving National Bank. Commercial Map of Latin America. Publ. by Irving National Bank. (Gift of Bank.)

**MISSISSIPPI STATE GEOLOGICAL SURVEY.** Oil and Gas Prospecting in Mississippi. By E. N. Lowe. Bulletin No. 15. 1919.

**MODERN PHOTOGRAPHIC DEVELOPERS.** The Photo Miniature, vol. 14, Jan., 1918. New York. (Gift of Samuel Wein.)

**PUBLIC UTILITIES REPORTS—ANNOTATED.** 1919 B. Rochester, N. Y.

**SHEET STEEL ENAMELS: A COMPARISON OF TEN WHITE ENAMELS FOR SHEET STEEL.** By Robert D. Landrum. (Reprint.)

**RESISTANCE OF SHEET STEEL ENAMELS TO SOLUTION BY ACETIC ACIDS OF VARIOUS STRENGTHS.** By Robert D. Landrum. (Reprint.)

**METHODS OF ANALYSIS FOR ENAMEL AND ENAMEL RAW MATERIALS.** By Robert D. Landrum. (Reprint.) (Gift of Robert D. Landrum.)

**STATESMAN'S YEARBOOK.** 1919. Edited by J. Scott Keltie. London.

### Trade Catalogs

**ALLIED MACHINERY CO. OF AMERICA,** New York City.  
Metal Working Machinery.

- GENERAL ELECTRIC Co., Schenectady, N. Y.  
 Bull. 47433A, June, 1919. Type FK-20 Oil Circuit Breakers for Industrial Service up to 300 Amperes and 2500 Volts.  
 Bull. 44721.2, July, 1919. Type SW-4 Automatic Sectionalizing Switch.  
 Geoc Resistor for Incandescent Headlights.
- GWILLIAM Co., New York City.  
 Ball Retainers and Ball Thrust Bearings. Bulletin No. 2.
- JEFFREY MFG. Co., Columbus, Ohio.  
 Jeffrey Straitflo Ventilators. Bull. 270.
- MERRILL Co., San Francisco, Calif.  
 Nordstrom Lubricated Plug Valve.
- STEPHENS-ADAMSON MFG. Co., Aurora, Ill.  
 The Labor Saver. No. 89. August, 1919. Monte Coal Co. Mine No. 3.
- UNITED FILTERS CORPN., New York City.  
 United Filter Press. Bull. 50.
- VULCAN SOOT CLEANER Co., Du Bois, Pa.  
 Six Vital Features of Vulcan Superiority.

## RECENT GOVERNMENT PUBLICATIONS

The following have been issued recently by the U. S. Geological Survey:

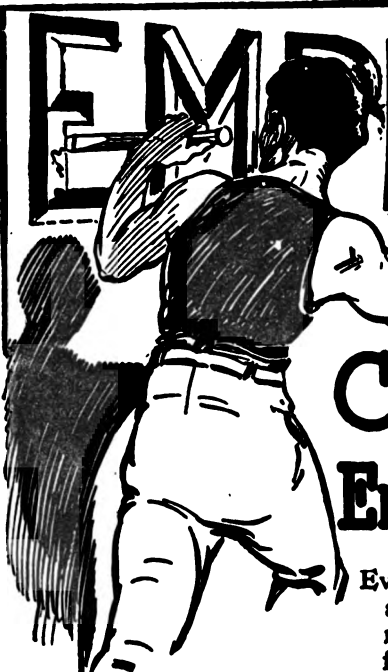
- Bulletin 692-B. Water-power Investigations and Mining Developments in South-eastern Alaska. Papers by G. H. Canfield, Theodore Chapin, and R. M. Overbeck. 95 pages, 2 plates.
- Bulletin 711-A. The Farnham Anticline, Carbon County, Utah, by F. R. Clark. 15 pages, 2 plates, 1 text figure.
- Part of Mineral Resources of the United States, 1916, namely:  
 Mineral Production of the United States in 1916; Introduction by H. D. McCaskey; Summary by Martha B. Clark. 72 pages, 1 text figure, 1 insert. Part I:A.
- Parts of Mineral Resources of the United States, 1918, namely:  
 Magnesium in 1918, by R. W. Stone. 11 pages. Part I:2.  
 Gems and Precious Stones in 1918, by W. T. Schaller. 9 pages. Part II:3.

## Maps

- Topographic maps (about 16½ by 20 in., except as otherwise noted) of the quadrangles named below are now ready for distribution by the U. S. Geological Survey. Price, 10 cents each; if included in wholesale orders amounting to \$3 net, 6 cents.
- Georgia: Egypt, long. 81°15'–81° 30'; lat. 32° 15'–32° 30'; scale, 1:62,500; contour interval, 10 ft.
- Kentucky-Virginia: Nolansburg, long. 83°–83° 15'; lat. 36° 45'–37°; scale, 1:62,500; contour interval, 50 ft.
- South Carolina: The Jetties, long. 79° 45'–79° 52' 30''; lat. 32° 37' 30''–32° 45'; scale, 1:21,120; contours offshore, 5, 10, and 20 ft. below mean low water; size, 26 by 30 in.
- Virginia: New Kent, long. 76° 45'–77°; lat. 37° 30'–37° 45'; scale, 1:62,500; contour intervals on land, 10 and 20 ft.; contours offshore, 5, 10, and 20 ft. below mean low water.
- Wisconsin: Sparta, long. 90° 45'–91°; lat. 43° 45'–44°; scale, 1:62,500; contour interval, 20 ft.

## Handbook on Export Trade Methods

"Selling in Foreign Markets," a book of 638 pages, prepared by the Bureau of Foreign and Domestic Commerce in conjunction with the Federal Board for Vocational Education, consists mainly of reports and articles by experts of wide experience, either in large private business or in commercial investigations for the Government. The price of this book is fifty cents, and it may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.



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## INDUSTRIAL SECTION

This department is devoted to material concerning the products or operations of manufacturers, which, in the estimation of the Editor, is of news value to the mining and metallurgical field, but does not come within the scope of the main editorial section of the Bulletin.

Manufacturers are invited to submit to the Editor items descriptive of new equipment or processes, large or significant installations, and similar material of news character. If found available, items thus furnished will be published in this section without charge, subject to such editorial revision and condensation as may be necessary.

In cases where illustrations are required, cuts of the proper size should accompany the text matter.

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### PAINT AND KEEP YOUR CREDIT GOOD

A prominent banker makes the statement that he is influenced in lending money to people by the appearance of their property. If houses, barns, and other buildings are painted as often as necessary in order to give them a spick and span appearance, he feels that they are a better risk than buildings that are neglected. Paint is also to some extent fire protection, since it is the slow combustion of the oxygen and other elements in the air that causes the decay of building material.

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### CHANGES IN AMERICAN CAR AND FOUNDRY CO.

The Directors of American Car and Foundry Co. recently abolished the office of General Manager. James M. Buick, formerly Vice-president and General Manager, has assumed the direction of the sales division of the company and will be known as Vice-president in Charge of Sales.

The production division will be directed by William C. Dickerman, who will be designated as Vice-president in Charge of Operations. He will be assisted by Frederick A. Stevenson, known as Assistant Vice-president in Charge of Operations, who will be head of the manufacturing section and have charge of production in the car plants, rolling mills and foundries. There will also come under Mr. Dickerman's supervision the engineering, improvement and research, patent and industrial relations sections. The headquarters of both divisions will be at the general offices, 165 Broadway, New York.

Both Mr. Dickerman and Mr. Stevenson have been connected with this company since its incorporation in 1899, advancing from apprenticeships in the shops to their present positions of responsibility. Mr. Dickerman, as head of the War Division and Mr. Stevenson as his assistant, directed the company's recent program in the manufacture of munitions for the Government of the United States and its Allies.

### REMOVAL OF HEADQUARTERS

The American Society for Testing Materials, which has heretofore had offices at the University of Pennsylvania, has now established Society Headquarters at the Engineers' Club Building, 1315 Spruce Street, Philadelphia, Pa.

### NEW EUROPE

A map of Europe that contains the latest boundary changes, probable future changes, etc., is now being distributed by the Deister Concentrator Co., of Fort Wayne, Ind.

### INDUSTRIAL NOTES

On June 20th, the Washington Office of the Anthracite Bureau of Information, located at 913 Woodward Building, Washington, D. C., was discontinued. All mail should be sent to the Main Office of the Bureau, 437 Chestnut Street, Philadelphia.

Mr. J. E. Graham is now sales engineer in the Huntington District, Mine Car Dept., Hyatt Roller Bearing Co., assisting Mr. Nash, the manager of that district.

Mr. S. G. Little has been appointed manager of the Pittsburgh District, Mine Car Dept., Hyatt Roller Bearing Co., with offices in Rooms 1272-73, Frick Annex, Pittsburgh, Pa. Mr. Joseph S. Larkin, sales engineer, will assist Mr. Little in the Pittsburgh district.

The Sullivan Machinery Co. announces the appointment of Mr. R. S. Weiner as district manager at El Paso, Tex., succeeding Mr. Don M. Sutor. Mr. Sutor has been transferred to the St. Louis office as district manager for Missouri, Eastern Texas, Oklahoma, Kansas, Western Kentucky and Western Tennessee.

The Jeffrey Mfg. Co. has opened a new branch office in Detroit in the Book Building, Washington St. between State and Grand Avenues. This office will be in charge of Mr. O. B. Wescott, who has had long and successful engineering experience in the Sales and Engineering-construction Department of the Jeffrey company.

Lieut. Clifford L. Snyder, who has just recently been discharged from the army, has joined the technical staff of The Detroit Testing Laboratory as sales engineer. Lieut. Snyder received his commission at Fort Sheridan, Illinois, and was later transferred to the Nitrate Division in charge of construction work at Plant No. 1, Sheffield, Alabama.

The Worthington Pump and Machinery Corp'n. announces its purchase of the plant, patterns, accounts, patents and other assets of the Epping-Carpenter Pump Co., located at Pittsburgh, Pa. The plant will be operated as the "Epping-Carpenter Works." Orders and contracts now in hand will be completed by the Worthington Pump and Machinery Corp'n., and all further business will be for its account.

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One-half the expense of maintaining the U. S. Employment Service is now being borne by chambers of commerce, welfare organizations, municipalities and other outside agencies. During July these outside contributions aggregated \$61,424.65. Because of this voluntary support, the Service has been able to maintain its previous placement rate, and soldiers and civilian workers were placed in jobs during July at the rate of 60,000 a week.

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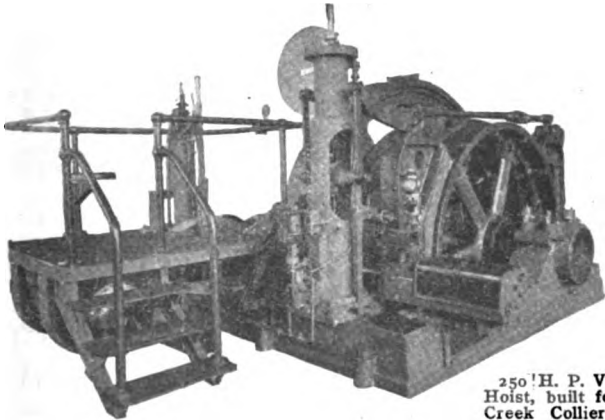
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# THE MINING AND METALLURGICAL INDEX

August, 1919

The Engineering Societies Library is prepared to supply the original, or a copy, translation, or abstract of any paper mentioned in the following index, at the following rates:

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In the following Index, volume numbers are given in heavy-faced figures, page numbers in light-faced figures. Approximate number of words is stated.

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| Sampling and Assaying.....                       | (26) |
| Geographical Index.....                          | (28) |

## MINERAL RESOURCES EXCLUSIVE OF COAL AND OIL

### GENERAL

- BELGIAN CONGO**, Mining in the. S. H. Ball and M. K. Shaler, *Engng. & Min. Jnl.* (Aug. 9, 1919) 108, 213-6. 3500 w. Copper, gold, tin, diamonds, and coal.
- BRITISH COLUMBIA**, Preliminary report on the economic geology of Haselton District. J. J. O'Neill, *Canad. Dept. Mines, Geol. Surv.* No. 89. Mem. 110. 1919. 37 pp.
- CLINTON DISTRICT**, B. C., Undeveloped mineral resources of the. L. Reinecke, *Bull. Canad. Min. Inst.* (Aug., 1919) 871-6. 1000 w. Serial.
- IRON industry**, On the. Algo sobre la industria siderurgica. R. Tison y Bueno, *Inform. y Mem. Soc. Ing. Peru* (Sept., 1918) 418-22. 1500 w.
- MACKENZIE River Basin**. C. Cammell and W. Malcolm, *Canad. Dept. Mines, Geol. Surv.* Mem. 108. No. 92. 133 pp. Economic geology; deposits, etc.
- ORE RESERVES**, Application of the theory of probability in the determination of. *Jnl. Chem., Met., and Min. Soc. of So. Afr.* (June, 1919) 19, 273-82. Discussion of G. A. Watermeyer's paper with author's reply.
- SIBERIA**, Mineral wealth of. *Min. Jnl.* (Aug. 2, 1919) 128, 515. 1800 w. Serial.
- UNITED STATES** in 1916, Mineral production of. Introduction, H. D. McCaskey. Summary, M. B. Clark, U. S. Geol. Surv., 1: A (June 28, 1919) *Mineral Resources of U. S.*, 1916, pt. 1, 1a-70a.
- WESTERN NEWFOUNDLAND**, Old mines of. E. D. Haliburton, *Canad. Min. Jnl.* (Aug. 6, 1919) 40, 589-90. 1800 w.

### FERROUS METALS

- BRAZILIAN iron ore**, Large deposits. A. I. Haasakari, *Commerce Repts.* (Aug. 4, 1919) 714. 250 w.

**IRON ore** in Canada considered in relation to the iron and steel industries. Production of coal and. *Iron & Steel of Canada* (Aug., 1919) 2, 177-9. 1000 w.

**LORRAINE ore** insures future for French iron and steel. *Iron Tr. Rev.* (July 31, 1919) 68, 296-7. 490 w.

**NOVA SCOTIA'S** oolitic iron deposits of sedimentary origin. A. O. Hayes, *Iron & Steel of Canada* (Aug., 1919) 2, 176. 800 w. Read before Min. Soc. of Nova Scotia, Apr. 23, 1919.

### NON-FERROUS METALS

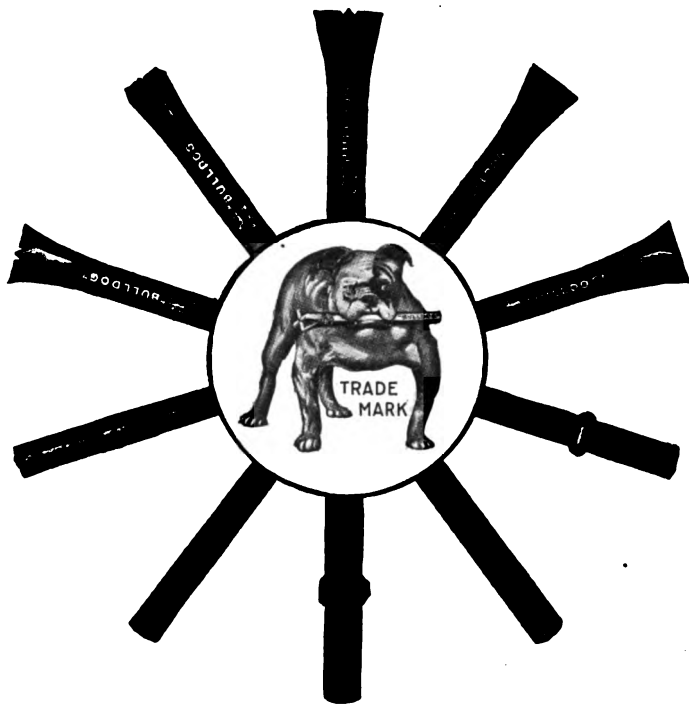
- ALLUVIAL GOLD** mine in Korea. *Queensland Govt. Min. Jnl.* (June 14, 1919) 20, 280. 1200 w. From *Far Eastern Rev.*, describing a mine near Pyeng Yang.
- HUNTINGDON** copper mine, Quebec. R. E. Hore, *Canad. Min. Jnl.* (Aug. 6, 1919) 40, 582-4. 1500 w.
- GOLD DISTRICT**, Ontario, West Shining Tree. L. H. Goodwin, *Engng. & Min. Jnl.* (Aug. 16, 1919) 108, 261-4. 2000 w.
- LEAD MINES**, Wanlockhead. J. Mitchell, *Min. Mag.* (July, 1919) 21, 11-20. 7000 w. In South Scotland.
- KIRKLAND LAKE**, Goldfield. H. H. Johnson, *Min. Mag.* (July, 1919) 21, 29-30. 1000 w. Opinion on prospects.
- MANITOBA**, Mining in northern. R. C. Wallace, *Min. & Eng. Rec.* (July, 1919) 24, 182-5. 1800 w. Copper and gold mines.
- SIMON silver-lead** and nearby properties. F. L. Miner, *Salt Lake Min. Rev.* (Aug. 15, 1919) 21, 25-7. 2000 w.
- TIN MINE**, A Bolivian. E. E. Miller, *Mine & Quarry* (July, 1919) 11, 1165-8. 1500 w.
- TIN MINES** of the Transvaal, Ancient. *Jnl. Chem., Met., and Min. Soc. of So. Afr.* (June, 1919) 19, 282-91. Discussion of M. Baumann's paper.

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 British Columbia: E. G. Prior & Co., Ltd., Victoria, B. C.  
 Copper Range: Wm. G. Phillips, Houghton, Mich.  
 Eastern Canada: H. L. Usborne, Toronto, Can.  
 New England States: Carroll Steel Co., Boston, Mass.

- TUNGSTEN.** El tungsteno. D. Pector, *Rev. Obras Pub.* (July 3, 1919) 321-4. 3500 w. Serial.
- TUNGSTEN**—Chinese tungsten and the American market. *Commerce Repts.* (Aug. 21, 1919) 970-2. 1700 w.
- TUNGSTEN** in Burmah. Le wolfram en Birmanie. *Echo d. Mines* (July 13, 20, 1919) 407. 500 w.
- TUNGSTEN** in Portugal. *Min. & Sci. Pr.* (Aug. 16, 1919) 119, 230. 400 w.

### NON-METALLIC MINERALS

- LIMESTONE** products: Urgent need of development in Great Britain. W. A. Brown, *Proc. So. Wales Inst. of Engrs.* (July 18, 1919) 88, 119-59.
- NITRATES.** Chilean, Future prospects of. *Chem. Age* (June 28, 1919) 1, 38. 600 w. From *Times Tr. Supplement*.
- ORE REDUCTION.** O. C. Bockman, *Canad. Pat.* 192155. *Off. Rec.* (Aug. 19, 1919) 47, 1376-7. 70 w.
- ORE-REDUCING** process. B. Q. P. Foss, U. S. Pat. 1311645. *Off. Gaz.* (July 29, 1919) 264, 800-1. 85 w.
- PAINT OXIDE.** *Indust. Austral.* (June 19, 1919) 61, 1161. 1000 w. From report of W. H. Twelvrees on deposits at Beaconsfield, Tasmania.
- PHOSPHATE** minerals and phosphate manure. Fosfati minerali e concimti fosfatici. E. Cortese, *Rassegna Mineraria* (Feb., 1919) 49, 25-7. 3000 w.
- POTASH.** American. H. H. Roe, *Min. & Sci. Pr.* (Aug. 9, 1919) 119, 195-8. 3000 w.
- POTASH** from Searles Lake. A. De Rupp, Jr., *Min. & Oil Bull.* (July, 1919) 8, 445-8, 459-60. 2500 w.
- POTASH** industry, Alsatian. F. K. Cameron, *Am. Fertiliser* (Aug. 16, 1919) 51, 49-54. 2500 w. Deposits, mining, etc.
- POTASH** mines of Alsace. *Chem. Age* (June 28, 1919) 1, 83. 500 w.
- ROAD** materials in the vicinity of Regina, Saskatchewan. L. Reinecke, *Canad. Dept. Mines, Geol. Surv. No. 90.* Mem. 107. 23 pp. 1919.
- SAND** and gravel, Missouri. *Cement, Mill & Quarry.* I. (Aug. 20, 1919) 18, 11-7. 3500 w. Serial.
- SUNFLOWER** opal in Peru. Study of the. Estudio del ópalo girasol en el Perú. G. R. Plaza, *Inform. y. Mem. Soc. Ing., Peru* (Jan., 1919) 7-20.
- TALC** and soapstone industry is improving. R. B. Ladoo, *Cement, Mill & Quarry* (July 20, 1919) 18, 39-40. 1630 w.

### GEOLOGY AND MINING PRACTICE

- AIR**—"Safety first" method for the estimation of CO<sub>2</sub> in mine air. H. R. S. Wilkes, *Jnl. Chem., Met., and Min. Soc. of So. Afr.* (May, 1919) 19, 246-9. 2000 w.
- AIR** in disused raises and backstopes. Notes on defective. C. J. Gray, with discussion. *Jnl. Chem., Met., and Min. Soc. of So. Afr.* (May, 1919) 19, 240-6. 5000 w.
- BRAKES** for mine hauling machinery with electric drive. Bremseneinrichtungen für Schachtfördermaschinen mit elektrischem antrieb, *Electro. u. Masch.* (Feb. 9, 1919) 21-2. 1000 w.
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**EXTRACTING** oils from carbonaceous material. G. E. Alderton, N. Z. Pat. 40491. *N. Z. Pat. Off. Jnl.* (June 26, 1919) 3, 315-6. 1800 w.

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### GENERAL

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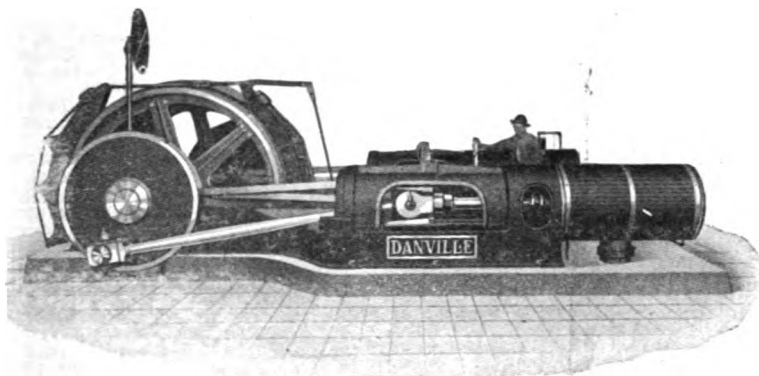
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- ALLOY steel.** Effect of rate of temperature change on the transformation in an. H. Scott, U. S. Bur. Standards, *Sci. Paper No.* 335, (July 10, 1919) 91-100. 2500 w.
- ALLOY steel, Flakes in.** E. E. Thum, *Chem. & Met. Engng.* (Aug. 1, 1919) 21, 145-6. 2000 w.
- ANALYTICAL methods for pig iron and steel.** Unification of. Unificazione dei metodi di analisi delle ghise e degli acciai. *Rassegna Mineraria* (Feb., 1919) 49, 29-32. 2000 w.
- BLAST furnace at Rotherham, New.** Le nouveau haut fourneau de la Park Gate Iron and Steel Co., & Rotherham (Angleterre). *Génie Civil* (July 19, 1919) 78, 49-51. 1500 w.
- BLAST furnaces, Pulverised coal for.** E. P. Mathewson and W. L. Wotherspoon. *Engng. & Min. Jnl.* (Aug. 16, 1919) 108, 274-8. 3500 w.
- BOILER-STEEL plates.** Physical tests of. F. Biggam, *Power* (Aug. 12, 1919) 50, 252-3. 2200 w.
- BRITISH machine tool and metal industries.** A. Luchars, *Iron Age* (Aug. 28, 1919) 104, 573-7. 5000 w. Report of conditions in Great Britain.
- CANADIAN iron and steel industry.** A. Stanfield, *Bull. Canad. Min. Inst.* (Aug., 1919) 843-6. 1500 w.
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- CEMENT from blast furnace slag.** W. Poole, *Cement, Mill & Quarry* (July 20, 1919) 16, 33-8. 4500 w.
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- ETCHED sections of steel forgings at low magnifications.** Photographing of. F. B. Foley, *Chem. & Met. Engng.* (Aug. 1, 1919) 21, 140. 700 w.
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- FRENCH operating German plants.** F. Miltoun, *Iron Tr. Rev.* (Aug. 21, 1919) 66, 501-3. 2000 w.
- FURNACE for melting metals.** W. Macleod, U. S. Pat. 1312129. *Off. Gas.* (Aug. 5, 1919) 52, 100 w.
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- HOT rolling of steels, Theories of.** Les théories du laminage à chaud. P. Maringer, *Rev. Univ. Mines Met.* (Feb., 1919) 1, 177-308.
- INGOT, etc., manipulators.** D. Kendall, British Pat. 128213. *III. Off. Jnl.* (Aug. 7, 1919) 2394. 80 w.
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- IRON and steel sheet industry, Features of the.** *Rau. Material* (July, 1919) 1, 255-60. 5000 w. Serial.
- MAGNETS, Steel for.** *Mech. Wld. V* (Aug. 1, 1919) 66, 57-8. 1500 w. Serial.
- MALLEABLE cast iron, Characteristics of.** *Iron Age* (Aug. 21, 1919) 104, 495-9. 4000 w. Abstract of three recent papers by H. A. Schwartz, W. R. Bean and E. Touceda.
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- METAL-CASTING apparatus.** J. C. Cromwell, U. S. Pat. 1312164. *Off. Gas.* (Aug. 5, 1919) 265, 59. 50 w.
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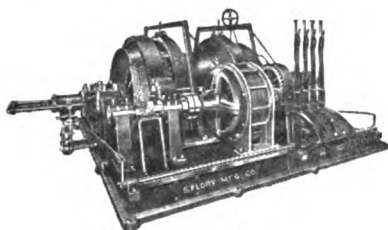
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**MOLD** for casting metal bars. H. Mueller Mfg. Co., Ltd., Canad. Pat. 192232. *Off. Rec.* (Aug. 19, 1919) 47, 1399. 200 w.

**NICKEL** in ferro-nickel and steels, Determination of. Dosage du nickel dans les ferro-nickels et les aciers. P. Nicolardot and G. Gourmain, *Bull. Soc. Chim. France* (June, 1919) 25-26, 338-44. 2200 w.

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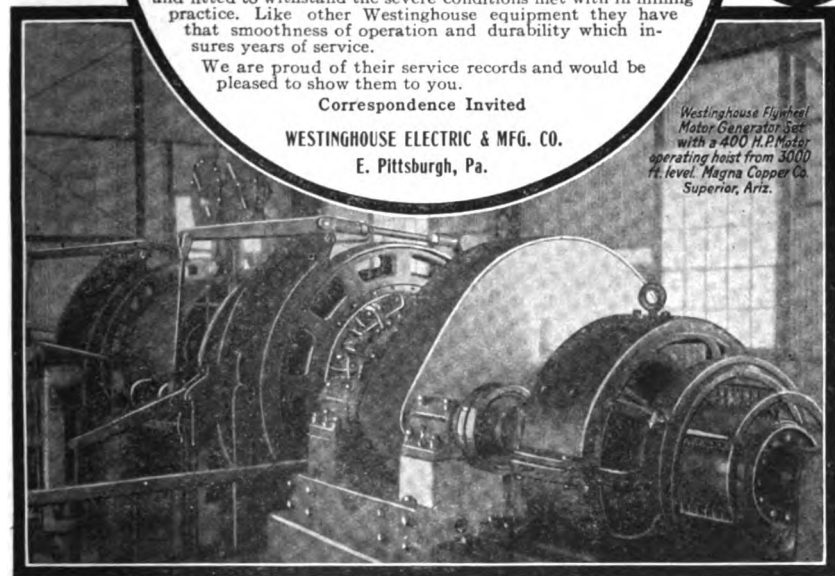
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- STEEL manufacture. R. A. Hadfield, *British Pat.* 127302. *Il. Off. Jnl.* (July 30, 1919) 2071. 250 w.
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- CASTING and welding processes, Electric. *Elektrisches Gless und Schweissverfahren.* H. Stösser, *Zsch. Ges. Glesserei-praxis* (Feb. 15, 1919) 81-3. 2500 w.
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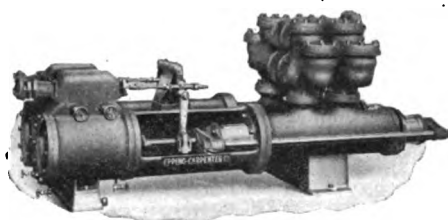
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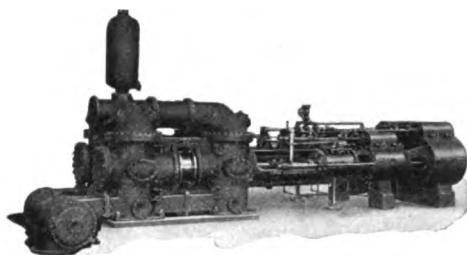
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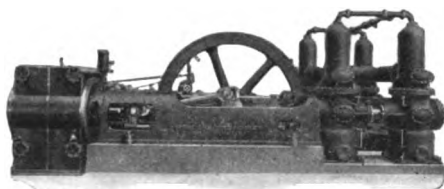
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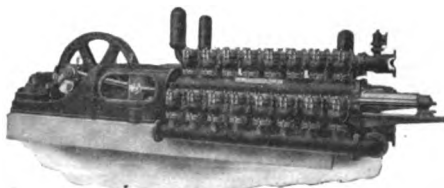
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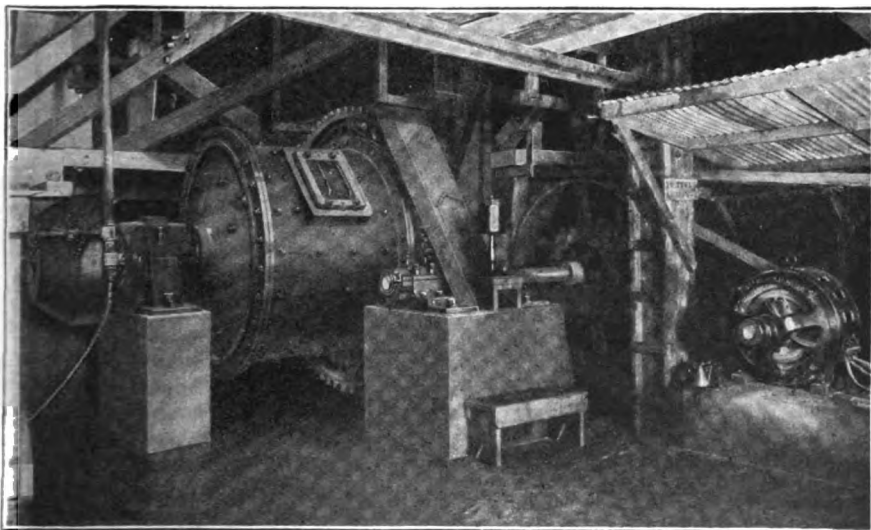
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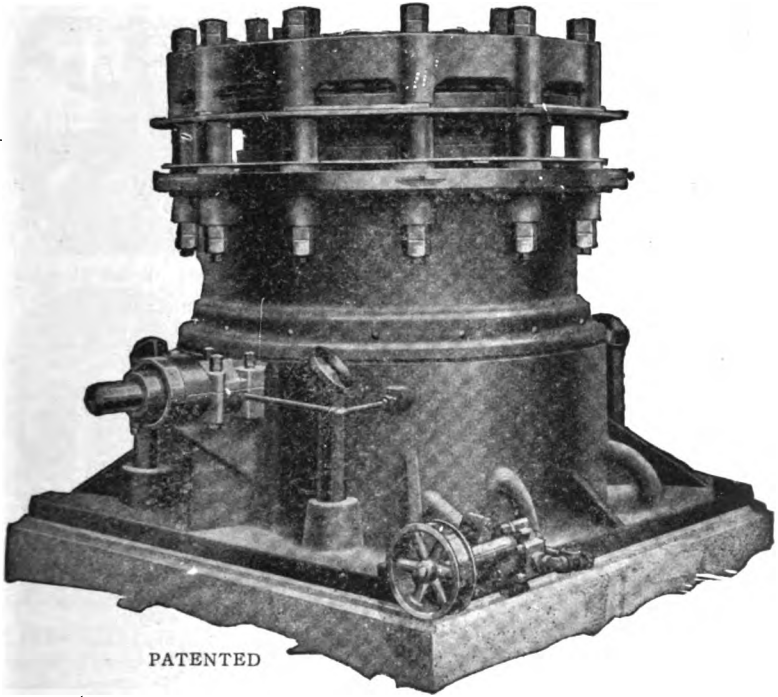
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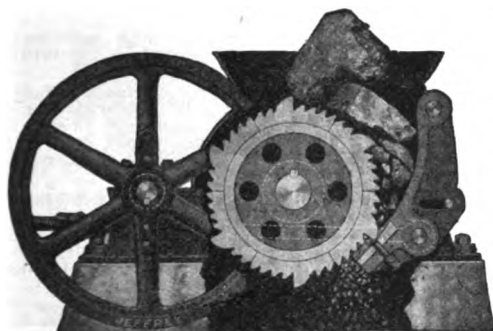
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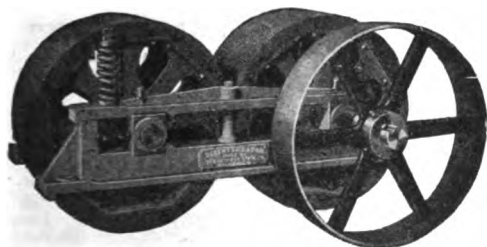
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- WELDING** of tungsten ingots. Planstiehl Co., Inc., *Canad. Pat.* 192001. *Off. Rec.* (Aug. 5, 1919) 47, 1309. 60 w.
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- LEAD** mines, Wanlockhead. J. Mitchell, *Min. Mag.* (July, 1919) 21, 11-20. 7000 w. In South Scotland.
- LIMESTONE** products: Urgent need of development in Great Britain. W. A. Brown, *Proc. So. Wales Inst. of Engrs.* (July 18, 1919) 35, 119-59.
- LORRAINE** ore insures future for French iron and steel. *Iron Tr. Rev.* (July 31, 1919) 65, 296-7. 490 w.
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- REFRACTORY** metals. Treating. W. Clarke, British Pat. 127708. *Ill. Off. Jnl.* (Aug. 7, 1919) 2219. 50 w. Articles of chromium, nickel, cobalt, etc.
- RENDERING** metals non-porous. F. C. Lea, British Pat. 127772. *Ill. Off. Jnl.* (Aug. 7, 1919) 2243. 50 w. Castings of aluminium, alloys, etc.
- RETORT** furnaces. C. H. Smith, British Pat. 126614. *Ill. Off. Jnl.* (July 16, 1919) 1826-7. 400 w. For carbonization of coal.
- ROLLING** metals. R. Linard, British Pat. 127541. *Ill. Off. Jnl.* (July 30, 1919) 2156. 130 w.
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### SOUTH AMERICA AND MEXICO

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- TIN** mine, A Bolivian. E. E. Miller, *Mine & Quarry* (July, 1919) 11, 1165-8. 1500 w.

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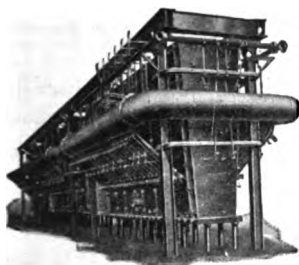
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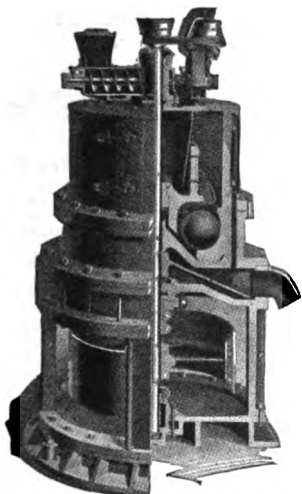
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Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Classifiers**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Deister Concentrator Co., Fort Wayne, Ind.  
Dorr Co., Denver, Colo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Coal and Ash Handling Machinery**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Coal Mining Machines**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Coal Mining Plants**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Coal Storage and Rehandling Machinery**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Coatings, Roof**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Compass, Mass Patent Drill Hole**  
Derby, Jr., E. L., Agent, Ishpeming, Mich.
- Compressors, Air**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Denver Hydro Co., 3100 Stuart St., Denver, Colo.  
General Electric Co., Schenectady, N. Y.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Concentrators**  
Colorado Iron Works Co., Denver, Colo.  
Deister Concentrator Co., Fort Wayne, Ind.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Condensers, Surface**  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Contractors, Diamond Drilling**  
Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Converters, Copper**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Converters, Electric, Rotary**  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Conveyors, Belt**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Robins Conveying Belt Co., Park Row Bldg., New York City.
- Conveyors, Cable Flight**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Conveyors, Chain Flight**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Conveyors, Pan or Apron**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Conveyors, Portable**  
Portable Machinery Co., Passaic, N. J.
- Conveyors, Screw**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Core Drilling**  
Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Coverings, Pipe and Boiler**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Crucibles**  
Heli Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.
- Crushers, Coal and Coke**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Crushers, Disc**  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.
- Crushers, Jaw**  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.
- Crushers, Ore**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Buchanan Co., C. G., 90 West St., New York City.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Fuller-Lehigh Co., Fullerton, Pa.  
Heli Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

# Pulverized Coal Equipment

Among some of the plants using our Pulverized Coal Equipment for heating Industrial Furnaces and Steam Boilers are the following:



American Iron & Steel Co., Open Hearth, Puddling and Heating Furnaces.

American Locomotive Works, Steam Boilers.

American Smelting & Refining Co., Reverberatory Furnaces.

American Steel & Wire Co., Open Hearth Furnaces.

American Steel & Wire Co., Heating Furnaces.

Atchison, Topeka & Santa Fe R. R., Locomotives.

Atlantic Steel Company, Open Hearth Furnaces.

Ash Grove Lime & Portland Cement Co., Steam Boilers.

Bethlehem Steel Co., Open Hearth Furnaces.

Choctaw Portland Cement Co., Steam Boilers.

Inland Steel Co., Heating Furnaces.

Lackawanna Steel Co., Calcining and also Flue Dust Nodulizing Kilns.

M. K. & T. Railroad, Steam Boilers.

Milwaukee Electric Light & Power Co., Steam Boilers.

Nichols Copper Company, Smelter.

Pacific Coast Coal Co., Steam Boilers.

Pittsburgh Malleable Iron Co., Malleable Furnaces.

Sizer Forge Company, Heating and Forging Furnaces & Steam Boilers.

Scranton Bolt & Nut Co., Heating & Puddling Furnaces.

Spanish-American Iron Co., Ore Roasting & Nodulizing Kilns.

Stone & Webster Co., Steam Boilers.

Union Carbide Company, Lime Kilns.

United Verde Ext. Mining Co., Reverberatory Furnaces & Steam Boilers.

Practically all the Cement Plants in the United States and Canada have installations of Fuller Mills.

Some of the above plants are using Pulverized Coal containing from 10% to 17% of ash for heating their metallurgical furnaces.

Fuller Mills are today pulverizing over 25,000 tons of coal per day for heating various types of furnaces.

The satisfactory performance of our Pulverized Coal Equipment warrants your investigation. We manufacture Coal Crushers, Dryers, Fuller-Lehigh Pulverizer Mills, and Pulverized Coal Feeders. All this equipment is described in our Catalogue No. 71 which we will be pleased to send you.

We also specialize in the manufacture of lining plates for tube mills, pebble mills, ball mills, screen plates, chute liners, and all castings subject to abrasive action. Inquiries covering equipment of this kind will receive our prompt attention.

## FULLER-LEHIGH COMPANY

Main Offices and Works: Fullerton, Pa., U. S. A.

BRANCH OFFICES:

New York, N. Y., 50 Church St.; Chicago, Ill., McCormick Bldg.; Parsons, Kan., First Nat. Bank Bldg.  
25 Victoria St., Westminster, S. W. I., London, England.

# CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Crushing and Grinding Machinery**  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.
- Crushing Roll Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.
- Crushing Rolls (See Rolls, Crushing)**
- Cupre-Vanadium**  
 Primos Chemical Co., Primos, Pa.
- Cyanide**  
 Rosander & Hamacher Chemical Co., 100 William St., New York City.
- Cyaniding Equipment**  
 Alfa-Chalmers Mfg. Co., Milwaukee, Wis.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Dorr Co., Denver, Colo.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Cyanide Plants**  
 National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.
- Dead Burned Magnesite**  
 Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Dewaterers**  
 Colorado Iron Works Co., Denver, Colo.  
 Dorr Co., Denver, Colo.  
 National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Diamond Drilling**  
 Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.
- Dredging Machinery**  
 Flory Mfg. Co., S., Bangor, Pa.
- Drill Hole Compass (See Compass, Drill Hole)**
- Drills, Core**  
 Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Drills, Diamond**  
 Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Drills, Electric**  
 General Electric Co., Schenectady, N. Y.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Drills, Hammer**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Drills, Prospecting**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Drills, Rock**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Dryers, Coal**  
 Ruggles-Coles Engineering Co., 60 Church St., New York City.
- Dryers, Ore**  
 Ruggles-Coles Engineering Co., 60 Church St., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Wedge Mechanical Furnace Co., Greenwich Point, Philadelphia, Pa.
- Dryers, Rotary**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Ruggles-Coles Engineering Co., 60 Church St., New York City.
- Dryers, Sand and Gravel**  
 Macleod Co., Bogen St., Cincinnati, Ohio.  
 Ruggles-Coles Engineering Co., 60 Church St., New York City.
- Dumps, Rotary**  
 Wood Equipment Co., McCormick Bldg., Chicago, Ill.
- Dynamite**  
 Atlas Powder Co., Wilmington, Del.  
 Du Pont de Nemours & Co., E. I., Wilmington, Del.  
 Hercules Powder Co., Wilmington, Del.
- Dynamos (See Generators, Electric)**
- Electrical Machinery**  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Elevators, Bucket**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- End Loaders (See Loaders, End)**
- Engines, Gas and Gasoline**  
 Alfa-Chalmers Mfg. Co., Milwaukee, Wis.
- Engines, Haulage**  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Engines, Hoisting**  
 Flory Mfg. Co., S., Bangor, Pa.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Engines, Oil**  
 Alfa-Chalmers Mfg. Co., Milwaukee, Wis.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Engines, Steam**  
 Alfa-Chalmers Mfg. Co., Milwaukee, Wis.
- Explosives**  
 Atlas Powder Co., Wilmington, Del.  
 Du Pont de Nemours & Co., E. I., Wilmington, Del.  
 Hercules Powder Co., Wilmington, Del.
- Fans, Ventilating**  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Feeders, Ore**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Ferro-Molybdenum**  
 Primos Chemical Co., Primos, Pa.
- Ferro-Tungsten**  
 Primos Chemical Co., Primos, Pa.

# THE WEDGE MECHANICAL FURNACE

(Patented)

## Metallurgical and Chemical Roasting Furnaces

Designed and Built to  
Meet Your Requirements

Write us stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per 24 hours, and results desired in the calcine.

**Wedge Mechanical Furnace Co.**  
**GREENWICH POINT, PHILADELPHIA**

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Ferro-Vanadium**  
Primos Chemical Co., Primos, Pa.
- Filtering Paper**  
Hall Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Filters**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Fire Clay**  
Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Flotation, Oil**  
Colorado Iron Works Co., Denver, Colo.
- Flue Welding Machines**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Fluorescent Calcium Tungstate**  
Primos Chemical Co., Primos, Pa.
- Forges, Oil and Rivet**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Forgings, Heavy**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Fuller Mill Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Furnaces, Assay**  
Hall Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Macleod Co., Bogen St., Cincinnati, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.
- Furnaces, Electric**  
General Electric Co., Schenectady, N. Y.  
Hall Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Furnaces, Fine Welding**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Furnaces, Gas**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Furnaces, Lead**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Furnaces, Mechanical Roasting**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Wedge Mechanical Furnace Co., Greenwich Point, Philadelphia, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Furnaces, Muffle**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Furnaces, Oil**  
Macleod Co., Bogen St., Cincinnati, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.
- Furnaces, Reverberatory**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Furnaces, Smelting**  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Furnaces, Tire Heating**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Gears**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Generators, Acetylene Welding and Cutting**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Generators, Electric**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Grinders, Sample**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Grizzly & Riffle Bars (For Hydraulic Mines)**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Guns, Cement**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Guns, Concrete**  
Macleod Co., Bogen St., Cincinnati, Ohio.
- Gyratory Crusher Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights, Ill.
- Hangers, Mine**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Hitchings Mine Car**  
Macomber & Whyte Rope Co., Kenosha, Wis.
- Hoisting Engines (See Engines, Hoisting)**
- Hoists, Electric**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Flory Mfg. Co., S. Bangor, Pa.  
General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Hoists, Skip**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Hoists, Steam**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Flory Mfg. Co., S. Bangor, Pa.  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Hoppers, Weigh**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Hose, Air**  
Goodrich Rubber Co., B. F., Akron, O.
- Hydraulic Mining Machinery**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Insulators, Third Rail**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Jackets, Water**  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Jaw Crusher Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights, Ill.

# ILLINOIS ZINC CO.

PERU, ILLINOIS

Manufacturers of

*Selected Brass Spelter  
Sulphuric Acid and  
Zinc Dust*

Rollers of

*Sheets, Plates and Strips in Coils*

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## ZINC

*in special sizes, squares and circles,  
cut to order. Etchers', Engravers',  
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### ILLINOIS ZINC COMPANY

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203 Broadway, New York

# CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

## Jigs

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Colorado Iron Works Co., Denver, Colo.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Laboratory Supplies

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## Lamps, Acetylene

Macleod Co., Bogen St., Cincinnati, Ohio.

## Lamps, Electric

General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Lead Acetate

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## Linings, Ball and Tube

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## Linings, Brake

John-Manville Co., H. W., 296 Madison Ave., New York City.

## Litharge

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## Loaders, End

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

## Loading Booms

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

## Locomotives, Compressed Air

General Electric Co., Schenectady, N. Y.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## Locomotives, Electric Trolley

General Electric Co., Schenectady, N. Y.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Locomotives, Gasoline

Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## Locomotives, Steam

Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## Locomotives, Storage Battery

General Electric Co., Schenectady, N. Y.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Magnesia Brick

Harblson-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.

## Magnetic Pulleys (See Pulleys, Magnetic)

## Meters, Air

Denver Hydro Co., 3100 Stuart St., Denver, Colo.

## Meters, Electric

General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Mills, Ball, Tube and Pebble

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Mills, Chilean

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## Mills, Stamp

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Mine Car Hitchings (See Hitchings, Mine Car)

## Mining Machinery

Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.

## Molybdate of Ammonia

Primos Chemical Co., Primos, Pa.

## Molybdate of Calcium

Primos Chemical Co., Primos, Pa.

## Molybdate of Soda

Primos Chemical Co., Primos, Pa.

## Molybdenum Metal

Primos Chemical Co., Primos, Pa.

## Molybdenum Ore, Buyers of

Primos Chemical Co., Primos, Pa.

## Molybdic Acid

Primos Chemical Co., Primos, Pa.

## Motors, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 General Electric Co., Schenectady, N. Y.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Muffles

Mine and Smelter Supply Co., 42 Broadway, New York City.

## Ore-Bedding Systems

Robins Conveying Belt Co., Park Row Bldg., New York City.

## Ore Handling Machinery

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.

## Ore Milling Machinery

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Ores, Buyers and Sellers of

Vogelstein & Co., Inc., L., 42 Broadway, New York City.

## Oxy-Acetylene Apparatus

Macleod Co., Bogen St., Cincinnati, Ohio.

## Packings, Steam

John-Manville Co., H. W., 296 Madison Ave., New York City.  
 Goodrich Rubber Co., B. F., Akron, O.

# Cyanide



Cyanide of Sodium 96/98  
Per Cent.

Cyanogen contents 51/52%

“Cyanegg”

Cyanide of Sodium 96/98% in egg  
form, each egg weighing one ounce.

Cyanogen contents 51/52%

*Manufactured in U. S. A.*

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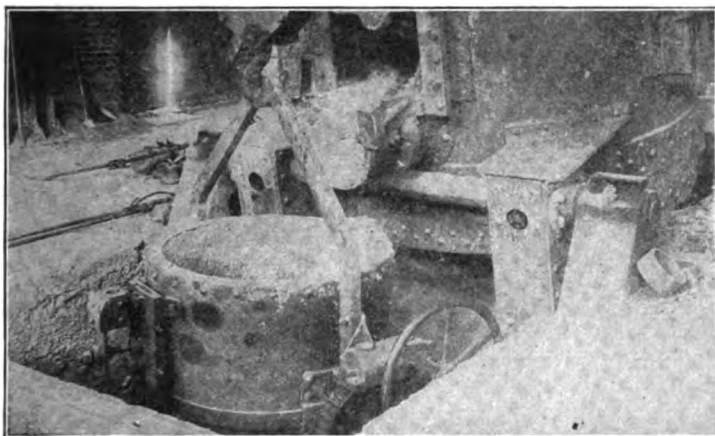
Niagara Falls, N. Y. St. Albans, W. Va.

Perth Amboy, N. J.

The  
Roessler & Hasslacher Chemical Co.  
100 William Street New York, N. Y.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Pipe Insulations**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Plate Metal Work**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Platinum Wire, Foil & Ware**  
Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Powder, Blasting**  
Atlas Powder Co., Wilmington, Del.  
Du Pont de Nemours & Co., E. I., Wilmington, Del.  
Hercules Powder Co., Wilmington, Del.
- Powdered Coal Equipment**  
Fuller-Lehigh Co., Fullerton, Pa.  
Ruggles-Coles Engineering Co., 50 Church St., New York City.
- Power Transmission Machinery**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Presses, Filter**  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pulleys, Magnetic**  
Buchanan Co., C. G., 90 West St., New York City.
- Pulverizer Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Pulverizers**  
Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Pulverizers, Coal and Coke**  
Fuller-Lehigh Co., Fullerton, Pa.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pulverizers, Ore**  
Fuller-Lehigh Co., Fullerton, Pa.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Acid**  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Centrifugal**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Epping-Carpenter Pump Co., Pittsburgh, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Hydraulic Pressure**  
Epping-Carpenter Pump Co., Pittsburgh, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Mine**  
Epping-Carpenter Pump Co., Pittsburgh, Pa.
- Pumps, Pneumatic Air Lift**  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Pumps, Power**  
Epping-Carpenter Pump Co., Pittsburgh, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Sand**  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pumps, Sinking**  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Stuff**  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Track**  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumping Engines (See Engines, Pumping)**
- Pyrometers**  
Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Quarrying Machinery**  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Refractories**  
Harbleon-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Respirators**  
Goodrich Rubber Co., B. F., Akron, O.  
Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Revolving Screen Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights, Ill.
- Rock Drill Steel (See Steel, Drill)**
- Rods, Drill**  
International High Speed Steel Co., 99 Nassau St., New York, N. Y.
- Roller Mill Parts**  
American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Rolls, Crushing**  
Buchanan Co., C. G., 90 West St., New York City.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Roofings, Asbestos and Rubber-type**  
Johns-Manville Co., H. W., 296 Madison Ave., New York City.
- Rope, Wire**  
Leechen & Sons Rope Co., A., 920 N. 1st St., St. Louis, Mo.  
Macomber & Whyte Rope Co., Kenosha, Wis.  
Roebbing's Sons Co., John A., Trenton, N. J.
- Rope Fastenings, Wire**  
Macomber & Whyte Rope Co., Kenosha, Wis.  
Roebbing's Sons Co., John A., Trenton, N. J.
- Rubber Goods, Mechanical**  
Goodrich Rubber Co., B. F., Akron, O.
- Samplers, Ore**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Scorifiers**  
Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Screens, Bar**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Screens, Perforated Metal**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Screens, Revolving**  
Buchanan Co., C. G., 90 West St., New York City.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Robins Conveying Belt Co., Park Row Bldg., New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.



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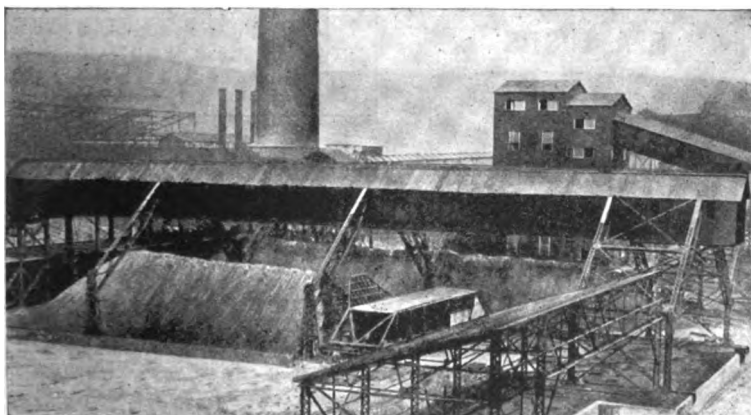
- Screens, Revolving (Continued)**  
 Worthington Pump & Machinery Corp'n.,  
 115 Broadway, New York City.
- Screens, Shaking**  
 Chalmers & Williams, Inc., 1465 Arnold St.  
 Chicago Heights, Ill.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St.,  
 Danville, Ill.
- Separators, Magnetic**  
 Buchanan Co., C. G., 90 West St., New York  
 City.
- Shaft Sinking and Development Work**  
 Longyear Co., E. J., 710 Security Bldg.,  
 Minneapolis, Minn.
- Sharpeners, Drill**  
 Denver Rook Drill Mfg. Co., Denver, Colo.  
 Sullivan Machinery Co., 122 So. Michigan  
 Ave., Chicago, Ill.
- Silica Brick**  
 Harbison-Walker Refractories Co., Farmers'  
 Bank Bldg., Pittsburgh, Pa.
- Skip Hoists (See Hoists, Skip)**  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Slime Filters (See Filters)**
- Smelters**  
 Vogelstein & Co., Inc., L., 42 Broadway,  
 New York City.
- Smelting Machinery**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown,  
 Pa.  
 Worthington Pump & Machinery Corp'n.,  
 115 Broadway, New York City.
- Soda Ash**  
 Hell Chemical Co., Henry, 210-214 S. 4th St.,  
 St. Louis, Mo.
- Spelter**  
 Illinois Zinc Co., Peru, Ill.
- Sprockets**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.
- Stamp Mill Parts**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights,  
 Ill.
- Steel, Drill, Hollow and Solid**  
 International High Speed Steel Co., 99 Nas-  
 sau St., New York, N. Y.  
 Sullivan Machinery Co., 122 So. Michigan  
 Ave., Chicago, Ill.
- Steel, Tool**  
 International High Speed Steel Co., 99 Nas-  
 sau St., New York, N. Y.
- Stokers**  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Switchboards**  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Tables, Concentrating (See Concentrators)**
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 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Tanks, Oil**  
 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Tanks, Water**  
 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Test Lead**  
 Hell Chemical Co., Henry, 210-214 S. 4th St.,  
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- Thermometers**  
 Hell Chemical Co., Henry, 210-214 S. 4th St.,  
 St. Louis, Mo.
- Thickeners, Slime**  
 Colorado Iron Works Co., Denver, Colo.  
 Dorr Co., Denver, Colo.
- Tipple Machinery Equipment**  
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 Macleod Co., Bogen St., Cincinnati, Ohio.
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 St. Louis, Mo.  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Transformers, Electric**  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Traps, Steam**  
 Johns-Manville Co., H. W., 296 Madison  
 Ave., New York City.
- Tungstate of Ammonia**  
 Primos Chemical Co., Primos, Pa.
- Tungstate of Soda**  
 Primos Chemical Co., Primos, Pa.
- Tungsten Ore, Buyers of**  
 Primos Chemical Co., Primos, Pa.
- Tungstic Acid**  
 Primos Chemical Co., Primos, Pa.
- Turbines, Hydraulic**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Turbines, Steam**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Valves, Air**  
 Denver Hydro Co., 3100 Stuart St., Denver,  
 Colo.
- Valves, Pump**  
 Goodrich Rubber Co., B. F., Akron, O.
- Vanadate of Ammonia**  
 Primos Chemical Co., Primos, Pa.
- Vanadic Acid**  
 Primos Chemical Co., Primos, Pa.
- Vanadium Chloride**  
 Primos Chemical Co., Primos, Pa.
- Vanadium Ore, Buyers of**  
 Primos Chemical Co., Primos, Pa.
- Ventilating Fans (See Fans, Ventilating)**
- Wagon Loaders**  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
 Ohio.
- Weigh Hoppers (See Hoppers, Weigh)**
- Wheels**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.
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 Fuller-Lehigh Co., Fullerton, Pa.
- Wire, Iron, Steel and Copper**  
 Roebling's Sons Co., John A., Trenton, N. J.
- Wire Mechanism (Lever Control)**  
 Gwilliam Co., 253 W. 58th St., New York  
 City.
- Wire Rope (See Rope, Wire)**
- Wires and Cables, Electrical**  
 General Electric Co., Schenectady, N. Y.  
 Goodrich Rubber Co., B. F., Akron, O.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Zinc Dust**  
 Vogelstein & Co., Inc., L., 42 Broadway,  
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- Zinc Sheet**  
 Illinois Zinc Co., Peru, Ill.

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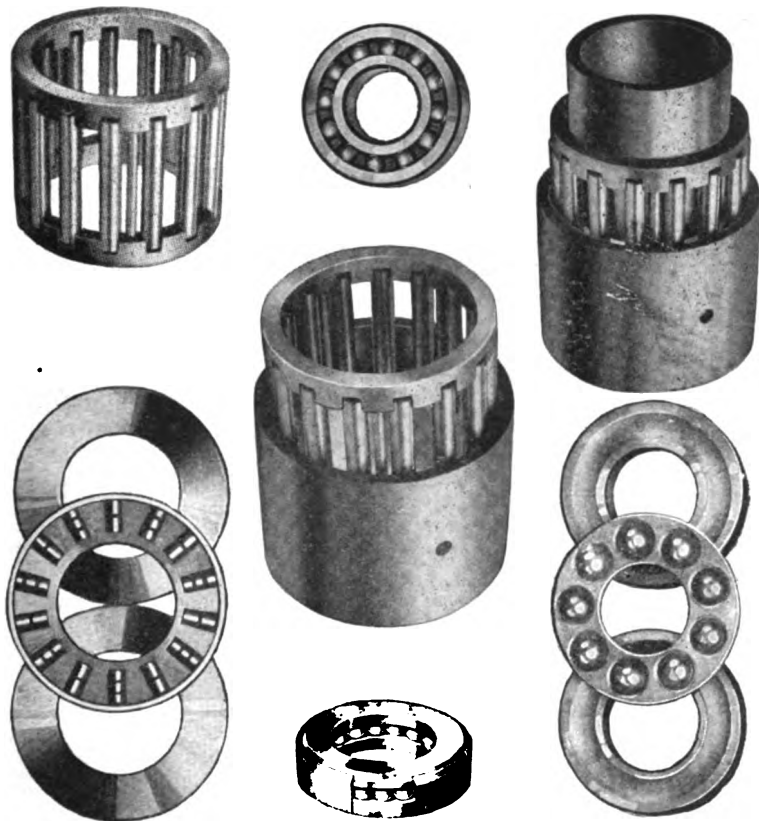
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# ALPHABETICAL LIST OF ADVERTISERS

(With Summary of Products)

See pages 32-44 for Classified List of Mining and Metallurgical Equipment

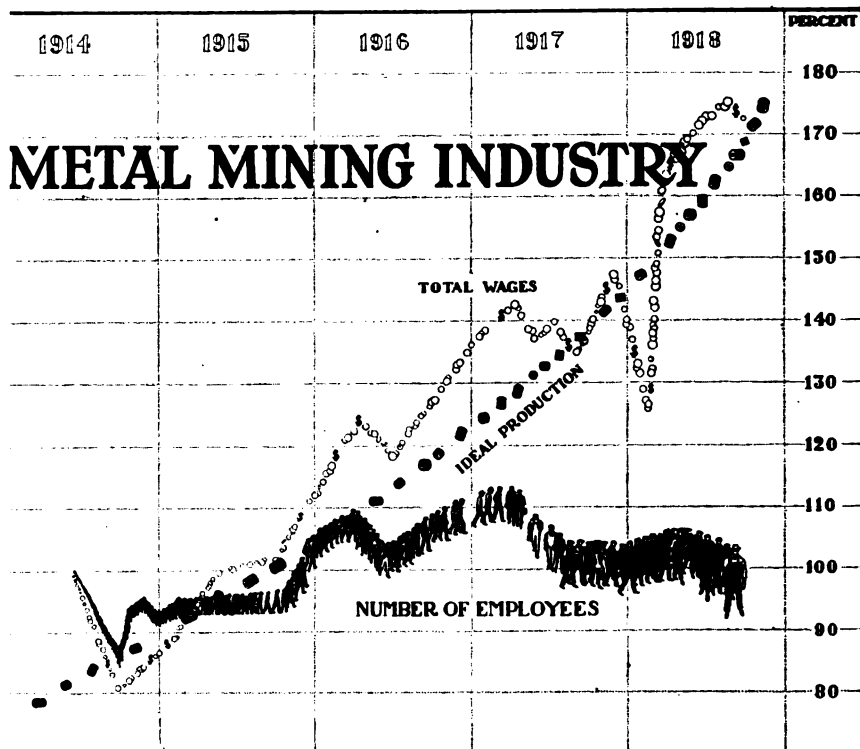
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| Allis-Chalmers Mfg. Co. ....  | 25   | Epping-Carpenter Pump Co. ....   | 23   |
| ADDRESS: Milwaukee, Wis.  |      | ADDRESS: Pittsburgh, Pa.   |      |
| PRODUCTS: Mining Machinery of Every Type. Complete Power and Electrical Equipments.   |      | PRODUCTS: Pumping Machinery and Condensers.  |      |
| American Manganese Steel Co. .... *   |      | Flory Mfg. Co., S. ....  | 17   |
| ADDRESS: McCormick Building, Chicago, Ill.  |      | ADDRESS: Bangor, Pa.   |      |
| PRODUCTS: Castings for Mining Machinery Parts.  |      | PRODUCTS: Mine and Contractors' Hoists, Cableways, Capstans, Winches, Marine Railway Hoists, etc.  |      |
| Atlas Powder Co. ....   | 11   | Fuller-Lehigh Co. ....   | 35   |
| ADDRESS: Wilmington, Del.   |      | ADDRESS: Fullerton, Pa.  |      |
| PRODUCTS: Manufacturers of Explosives.  |      | PRODUCTS: The Fuller-Lehigh Pulveriser Mill, Cement Mill Machinery, Powdered Coal Equipment, Gyratory Crushers, Roll Crushers, Rotary Dryers, Car Wheels and Axles, Chemical Castings, Charcoal Iron Castings, Chilled Castings.   |      |
| Buchanan Co., C. G. .... *  |      | General Electric Co.,  |      |
| ADDRESS: 90 West St., New York City.  |      | Outside Back Cover   |      |
| PRODUCTS: Crushing and Magnetic Concentrating Plants Complete in All Details. Rock and Ore Crushers, Crushing Rolls, Magnetic Separators, Revolving Screens, Bucket Elevators, Ore Feeders. |      | ADDRESS: Schenectady, N. Y.  |      |
| Car Dumper and Equipment Co. ....   | 21   | PRODUCTS: Electric Mine Locomotives. Electric Motors for Operating Mining Machinery.   |      |
| ADDRESS: McCormick Bldg., Chicago, Ill.   |      | Goodrich Rubber Co., B. F.,  |      |
| PRODUCTS: The Pneumatic Rotary Dump (Wood and Ramsay Patents). Adaptable to all mining conditions—old or new operations.  |      | Inside Back Cover  |      |
| Chalmers & Williams, Inc. ....  | 27   | ADDRESS: Akron, O.   |      |
| ADDRESS: 1465 Arnold St., Chicago Heights, Ill.   |      | PRODUCTS: Goodrich "Longlife," "Dredge," Vanner, Take-off and Magnetic Separator Conveyor Belts.   |      |
| PRODUCTS: Mining and Crushing Machinery.  |      | Gwiliam Co. ....   | 47   |
| Colorado Iron Works Co.,  |      | ADDRESS: 253 W. 58th St., New York City.   |      |
| Inside Front Cover  |      | PRODUCTS: Ball and Roller Bearings. The Bowden Patent Wire Mechanism for the Transmission of Reciprocating Motion Through a Flexible and Tortuous Route.   |      |
| ADDRESS: Denver, Colo.  |      | Harbison-Walker Refractories Co. .... *  |      |
| PRODUCTS: Complete Equipment for Cyanide and Concentrating Mills and Smelting Plants.   |      | ADDRESS: Pittsburg, Penna.   |      |
| Deister Concentrator Co. .... *   |      | PRODUCTS: Refractories for Blast Furnace and the Open Hearth, Electrical Furnaces, Copper Smelting Plants, Lead Refineries, Nickel Smelters, Silver Slimes and Dross Furnaces, Alloy Furnaces, as well as all other types in use in the various metallurgical processes. |      |
| ADDRESS: Ft. Wayne, Ind.  |      | Heil Chemical Co., Henry .... *  |      |
| PRODUCTS: Deister, Overstrom and Deister-Overstrom Tables in either Single or Double Deck Types.  |      | ADDRESS: 210-214 S. 4th St., St. Louis, Mo.  |      |
| Denver Hydro Co. .... *   |      | PRODUCTS: Chemicals and Chemical Apparatus. Supplies for Mines, Smelters, Iron and Steel Works, Schools, Colleges, and Universities.   |      |
| ADDRESS: 3100 Stuart St., Denver, Colo.   |      | Hercules Powder Co. ....   | 9    |
| PRODUCTS: Hydraulic Air Compressors, Excelsior Airmeters, The Sentinel Automatic Valve.   |      | ADDRESS: Wilmington, Del.  |      |
| Derby, Jr., E. L., Agent. .... *  |      | PRODUCTS: Explosives, Blasting Powder, Dynamite, etc.  |      |
| ADDRESS: Ishpeming, Mich.   |      | Holmes & Bros., Inc., Robt. ....   | 15   |
| PRODUCTS: The Mass Drill Hole Compass for determining direction and dip.  |      | ADDRESS: 30 N. Hazel St., Danville, Ill.   |      |
| Dorr Co. .... *   |      | PRODUCTS: Engineers, Founders, Machinists and Boiler Makers. Builders of Hoisting and Haulage Engines, Shake Screens and Weigh Hoppers, Self Dumping Cages and Empty Car Lifts, Mill and Mine Supplies.  |      |
| ADDRESS: Denver, Colo.  |      |  |      |
| PRODUCTS: Machinery in use for Cyaniding. Wet Gravity Concentration, Flotation, Leaching Copper Ores and many non-metallurgical industrial processes.                                       |      |  |      |
| Du Pont de Nemours & Co., E. I., ...  | 13   |  |      |
| ADDRESS: Wilmington, Del.   |      |  |      |
| PRODUCTS: Explosives, Blasting Powder, Dynamite, etc.   |      |  |      |

\*Advertisement does not appear in this issue, but products are listed in Classified List of Mining and Metallurgical Equipment.

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| PRODUCTS: Roller Bearings.   |      | PRODUCTS: Molybdenum, Tungsten and Vanadium Products. Buyers of Molybdenum, Tungsten and Vanadium Ores.  |      |
| Illinois Zinc Co. ....   | 39   | Robins Conveying Belt Co. .... 45  |      |
| ADDRESS: Peru, Ill.  |      | ADDRESS: Park Row Bldg., New York City.  |      |
| PRODUCTS: Spelter, Sheet Zinc and Sulphuric Acid.  |      | PRODUCTS: Belt Conveyors, Bucket Elevators, Ore Bedding Systems, Unloading, Stocking and Reclaiming Towers and Bridges, Conveyor Auxiliaries.  |      |
| International High Speed Steel Co. . . . 7   |      | Roebing's Sons Co., John A. .... *   |      |
| ADDRESS: 99 Nassau St., New York City.   |      | ADDRESS: Trenton, N. J.  |      |
| PRODUCTS: Drill Steel, Tool Steel, Drill Rods.   |      | PRODUCTS: Wire Rope for Mining Work. Stock shipments from agencies and branches throughout the country.  |      |
| Jeffrey Mfg. Co. ....  | 29   | Roessler & Hasslacher Chemical Co. 41  |      |
| ADDRESS: 902 N. Fourth St., Columbus, O.   |      | ADDRESS: 100 William St., New York.  |      |
| PRODUCTS: Electric Coal Cutters and Drills; Electric and Storage Battery Locomotives; Coal Tipple Machinery including Elevators, Conveyors, Picking Tables and Loading Booms, Car Hauls, Car Dumps, Screens, Crushers, Pulverisers, Fans, Hoists, etc. |      | PRODUCTS: Cyanide of Sodium and Other Chemicals for Mining Purposes.   |      |
| Johns-Manville Co., H. W. .... *   |      | Ruggles-Coles Engineering Co. .... *   |      |
| ADDRESS: New York City.  |      | ADDRESS: 50 Church Street, New York.   |      |
| PRODUCTS: Asbestos and Rubber-type Roofings, Roof Coating, Steam Packings, Pipe Insulations, Cements, Brake Lining and Brake Blocks, Steam Traps, Third Rail Insulators, Mine Hangers, Moulded Mica Weatherproof Sockets, Electrical Tapes and Fuses.  |      | PRODUCTS: Manufacturers of the Ruggles-Coles Dryer for All Materials. Powdered Coal Equipment.   |      |
| Leschen & Sons Rope Co., A. .... *   |      | Sullivan Machinery Co. .... *  |      |
| ADDRESS: St. Louis, Mo.  |      | ADDRESS: 122 S. Michigan Ave., Chicago, Ill.   |      |
| PRODUCTS: Wire Rope for all purposes, including Hercules Red Strand Wire Rope, and Wire Ropes of Patent Flattened Strand and Locked Coil constructions. Aerial Wire Rope Tramways for economical transportation of material.                           |      | PRODUCTS: Coal Pick Machines, Air Compressors, Diamond Core Drills, Rock Drills, Hammer Drills, Mine Hoists, Chain Cutter, Bar Machines, Fans.   |      |
| Longyear Co., E. J. .... *   |      | Traylor Engineering & Mfg. Co. .... 31   |      |
| ADDRESS: 710 Security Bldg., Minneapolis, Minn.  |      | ADDRESS: Allentown, Pa.  |      |
| PRODUCTS: Contract Diamond Drilling, Manufacture of Diamond Drills and Supplies, Shaft Sinking and Development Work, Geological Department.  |      | PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.   |      |
| Macomber & Whyte Rope Co. .... *   |      | Vogelstein & Co., Inc., L. .... *  |      |
| ADDRESS: Kenosha, Wis.   |      | ADDRESS: 42 Broadway, New York.  |      |
| PRODUCTS: Monarch Whyte Strand Wire Rope, Patent Killindo Non-Rotating Wire Rope, Wire Rope of all Grades and Constructions. Patent Monarch Mine Car Hitchings.  |      | PRODUCTS: Buyers, Smelters and Refiners of Ores and Metals of all classes.   |      |
| Mine & Smelter Supply Co. .... *   |      | Vulcan Iron Works. .... 5  |      |
| ADDRESS: 42 Broadway, New York City.   |      | ADDRESS: Wilkes-Barre, Pa.   |      |
| PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.   |      | PRODUCTS: Vulcan Electric Mine Hoists, Steam Hoists, Hoisting and Haulage Engines, Mining Machinery, etc. Nicholson Device for Prevention of Overwinding.  |      |
| National Tank & Pipe Co. .... *  |      | Wedge Mechanical Furnace Co. .... 37   |      |
| ADDRESS: 275 V Oak St., Portland, Ore.   |      | ADDRESS: Greenwich Point, Philadelphia, Pa.  |      |
| PRODUCTS: Water, Oil, Mining and Cyanide Tanks; Cross Arms and Silos.  |      | PRODUCTS: The Wedge Mechanical Roasting Furnace (Patented).  |      |
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# MINING AND METALLURGY

BULLETIN OF THE  
AMERICAN INSTITUTE OF MINING  
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AMERICAN INSTITUTE OF METALS



## SPECIAL FEATURES

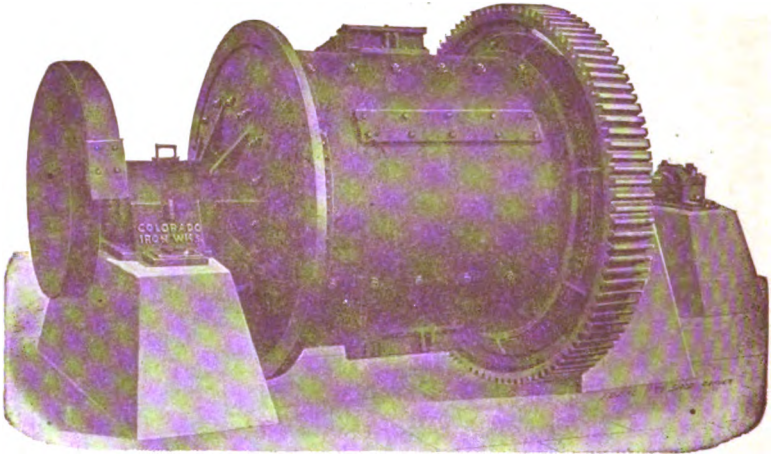
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PUBLISHED MONTHLY

NUMBER 155

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# MINING AND METALLURGY

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of

## Mining and Metallurgical Engineers

with which is consolidated the  
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### PROCEEDINGS OF THE ONE HUNDRED AND TWENTIETH MEETING AT CHICAGO

The one hundred and twentieth meeting of the Institute was held at Chicago, Sept. 22 to 26, inclusive, and was in every way a success although the steel strike against the United States Steel Corp'n. prevented many engineers from attending the steel session and made necessary the annulment of the trip to the steel works at Gary on Tuesday.

All of the meetings were held at the Congress Hotel, with the exception of the session on Non-ferrous Metallurgy which was held at the Coliseum where the Fifth National Exposition of Chemical Industries was in progress. This session was a joint one with the American Electrochemical Society.

The total attendance, as shown by the registration, was 850.

The session on Mine Taxation on Monday morning developed so much discussion that it ran into two sessions on Tuesday. This important subject created such widespread interest both among the members present and the members who were absent, as developed by letters and telegrams, that President Winchell appointed a committee of twenty-four to go to Washington, at the invitation of the Commissioner of Internal Revenue, for a two-day session beginning Oct. 6.

The symposium on Sulfur in Coal and the one on Pyrometry were most successful; the papers and discussions of the latter will be published in a special volume which will probably exceed 750 pages and will be the last word on the subject. All of the other sessions were very well attended and the papers, which were of unusual merit, brought out some very valuable discussions.



THE A. I. M. E. SMOKER AT THE CONGRESS HOTEL, CHICAGO, SEPT. 22, 1919.

THE SMOKER, MONDAY EVENING

The smoker, Monday evening, was an unusual success. It was held in the beautiful gold room of the Congress hotel, which was very elaborately decorated with American flags. More than 500 were present. The gallery was filled with ladies, who responded to the request of the song leader and helped in many ways to grace the occasion. The entertainment was a varied one and was original with the Chicago Committee, which deserves great credit for the unusual success of the event. Although it was mostly funmaking, Dr. F. B. Cottrell and George S. Rice of the Bureau of Mines gave some very interesting talks, illustrated by flags and moving pictures, of their trip through Europe since the armistice. Mr. Rice's talk dealt particularly with the demonstrative coal and iron regions and Doctor Cottrell's was devoted almost solely to that part of his trip in Northern Italy where he was investigating the application of volcanic steam to power purposes. This steam is derived from boracic-acid springs and helium is secured as a byproduct.

A. I. M. E. CHORUS

The following parody on one of the popular songs of the day was written for the Smoker and made quite a hit:

How ya gonna keep em, down in the mine,  
After the Avenue?

How ya gonna keep em, away from the throng,  
Jazzin' along, with speeches and song?

How ya gonna put them, back into line?  
That's a mystery.

They'll never want to see a pick or bar,  
And who the deuce is goin to tram a car?

How ya gonna keep em, down in the mine,  
After the Avenue.

---

FOREIGN GUESTS AT THE INSTITUTE MEETING

There were two official representatives of Foreign Governments as guests at the Chicago Meeting.

One was Frederick Goransson, managing director of the Sandvikens Steel Works, who represented the Jernkonteret, the Iron and Steel Institute of Sweden, and who came to this country especially for our meeting.

The other distinguished guest was Commander Toublet, who represented the French Embassy. Commander Toublet delivered a most polished address at the Banquet, dealing with the felicitous relations existing between this country and France for the last 150 years. Commander Toublet was accompanied by Mrs. Toublet, who won the hearts of all the ladies present, whose guest she was.



THE A. I. M. E. BANQUET AT THE CONGRESS HOTEL, CHICAGO, SEPT. 24, 1919.

## THE BANQUET, WEDNESDAY EVENING

The banquet Wednesday evening was attended by about 700. The list of speakers was unusually brilliant and each one proved to be so interesting that it was nearly midnight before the dancing began. Capt. Robert W. Hunt was toastmaster. Captain Hunt is about to celebrate his eighty-first birthday but is blest with unusual vigor and it was a great pleasure to all his friends to honor him at this time. His selection as toastmaster was a happy one. The guest of the evening, if among so many stars one could be selected from the rest, was Charles M. Schwab, who said nothing but the urgent telegram from his dear old friend, Captain Hunt, could have drawn him away from his seclusion on his Pennsylvania farm to attend the meeting in Chicago. Mr. Schwab's address was, as usual, scintillating with wit and humor; and while he did not directly or indirectly allude to the steel strike he did at the end of his talk discuss serious things and gave it as his opinion that any effort to legislate or control the high cost of living would be futile until this country got down to a basis of an honest day's work for an honest day's wage.

## ADDRESS OF HORACE V. WINCHELL

On behalf of the members and directors of the American Institute of Mining and Metallurgical Engineers, I desire to express our appreciation of the diligent labors and many thoughtful courtesies of the Chicago members which have culminated in this splendid gathering here tonight. We have enjoyed the cordial atmosphere of welcome by which we have been surrounded, we have profited by the many interesting discussions of the past three days, and we shall long remember with gratitude the manifestations of friendship which have attended our brief sojourn in Chicago.

We look upon these, our annual mid-year gatherings in different sections of the country, as one of the most effective agencies in the forming of acquaintance with many whom we might otherwise never meet. In this way are brought together men of common aims and similar lines of investigation, and through the interchange of ideas and the friction of personalities are often developed a warmth of interest and a fruition of conception which lead not only to lifelong friendships but to results of importance in our social and economic development. Those of us who were here in 1893 and listened to the discussions of Posepny's paper on the genesis of ores received an inspiration and a stimulus which perhaps have played no small part in the vastly greater study and the clearer understanding of that subject which in the past quarter of a century have been marked by a progress greater than that of all antecedent time. Nor is this the only epoch-making monograph which has first been promulgated at our meetings. I have no doubt whatever that some of the ideas advanced in our technical sessions this week contain germs of thought susceptible of great future elaboration and that these germs if not already fully developed will bear rare fruit in succeeding years.

May we not therefore congratulate ourselves and thank our hosts in this great metropolis because of this record-breaking attendance here this evening? Truly a high mark has been set in the history of Institute events.

In glancing backward over the past 25 years we become conscious of many changes, not alone in the scale of production nor in our methods of

operation but also in the more intangible but none the less important conception of the relation of the engineer to society in general and more especially to his own particular community. Although it is to be feared that there is some foundation for the statement recently made to the Chairman of the National Service Committee of the Engineering Council by "an acknowledged statesman and keen observer of events" that "Engineers are the most unresponsive citizens that we have \* \* \* Their aloofness and indifference in all matters outside of their own professional sphere are among the unexplained things in our political life," there are signs of an awakening, and the future is not without promise.<sup>1</sup>

Our Institute itself, an organization which was for many years forbidden by its organic law from exerting any influence on law-making bodies, or even presenting its views as an organized unit of professional men regarding any movement which affected the general community, has recently removed these restrictions and is now able legally and with perfect propriety to appoint its committees and representatives to lend professional advice and assistance to any and all public and governmental agencies which may in any way shape and control legislation and national activities.

Recent events have shown us that the fabric of human relationship is each year more closely interwoven. The strands are ever closer and more firmly drawn and each separate thread is a sensitized nerve alive with electricity and communicating instant warning of danger and news of damage to every other vital part. The development and perfecting of means of communication and transportation and the arrival of an industrial age have made all the world neighbors and just as a fire in your neighbor's house is always a matter of concern to you, so an incipient conflagration of social or economic unrest or disorder in any part of the civilized world has now come to have its effect upon every other part. I have said before, and it cannot be too often repeated, that from the historic moment when Admiral Dewey sailed into Manila Bay and upset the coffee cups of the Spanish Navy we the United States of America are by force of natural law, and whether we wish it or not, partners in the commonwealth of nations. We may legislate against it; we may make treaties with reservations, or no treaties at all; we may set up barriers and lock the doors against all foreigners, black, white or yellow; but if because of our acts or for any other reason, these excluded and distant peoples engage in conflict among themselves, we shall again, in spite of our wishes, our barriers and our padlocks, be drawn into the fray.

Nor is it in time of war alone that we find ourselves indissolubly harnessed up with the rest of mankind. Each smallest fluctuation in the annual production of the farms of Europe or of Argentine is reflected in our markets; each drouth or famine, each outburst of Bolshevism, each overthrow of a tyrannical government in any part of the globe affects each and every one of us, down to the youngest babe in its cradle or the poorest paid worker in a sweatshop. Social diseases of the body politic are like the influenza, they are pandemic, they are in the air and are not excluded by bolts nor barred gateways, by statutes nor standing armies.

Nor may we blind our eyes to the fact that at the present time,

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<sup>1</sup> *Engineering and Mining Journal* (Sept. 13, 1919) 439.

under the order of divine providence, the United States is the only great nation whose resources are not only unimpaired but incomparably greater than ever before; that the nations of Europe are exhausted and almost bankrupt; that it is our privilege and our duty to them as well as to ourselves to go to their rescue. This was made so clear by our illustrious member, Herbert Hoover, in his address at New York last week, that it requires no emphasis from me. I presume each of you will soon receive that address in printed form. I advise you to learn it by heart and loan it to all of your friends. I wish that it could be read by every intelligent person between the Atlantic and Pacific; that it could be used as a text by every minister and as a reading lesson for a week in every high school. It emanated from a heart wrung by the woes of suffering millions and from a brain clear enough and broad enough to analyze the causes for Europe's condition and to perceive clearly the only remedy. It is a source of inspiration to us and one of supreme gratification to all engineers that in a time of crisis, in a period that tries men's souls, at a moment when the real man comes to the front and assumes that position of leadership to which, by his mental attributes and moral courage he is naturally entitled, it should have been a mining engineer to whom the world turned for relief, and that for his trusted and most effective coadjutors, he chose many other engineers.

Does this not suggest to us that engineers are needed in the settlement of the world's affairs? Do we not realize that there is prevalent as an aftermath of war, and the artificial conditions created by it, a wide-spread feeling of discontent? Are we not still, and more than ever, ready to apply to the solutions of post-war problems, the mental poise and balanced judgment which are a part of the equipment of the trained engineer? Shall we be so modest and retiring or so engrossed in our technical duties as to forget or neglect our duties as citizens?

Just at this point my subliminal ear detects a murmur. What do you say? "We cannot all be Hoovers or Presidents or Members of Congress?" No, of course not! But you can help to make or unmake them, to influence them, and to shape the policies of government and the destinies of nations. Why is President Wilson touring the country today? Is it not to shape public opinion? He knows that the world is ruled by ideas, and that there is no greater force than public opinion. Suppose all the engineers of this broad republic should unite and devote all of their spare time and energy for six months in advocating some change in our statutes which clearly appealed to their sense of equity as promoting the public welfare, do you not suppose they could overcome the apathy and selfish inertia of our chief law-making body? Of course, they could. Well, it would not be you or I, but all of us, who would have done it. It would be the result of coöperation and organized effort, in which each individual pulled in the same direction and not at cross-purposes with the rest.

Now, this is all trite; and in one form or another has been said many times. You want perhaps to know just what particular move to make next, and just how and where to begin. And these questions I cannot answer; but I may, with your permission, make a few suggestions.

There are problems constantly before us of public character and yet of direct and vital importance to each one of us engineers. Some of these problems are comparatively local in their sphere of bearing and applica-

tion, some are nation wide, and some of them are international in scope. We have, for example, in each state and county, local taxation questions. As applied to mines and quarries, to mills and smelters, and to many other industrial plants, the valuation of properties for taxation involves questions which require engineering ability of high order, and keen analysis by the best brains of the country. The same problems are now presented in connection with the Federal Income Tax law. Indeed, there are few subjects of wider general bearing and importance, nor any which make more pressing demand upon the engineering talent of the land. That we have not been consulted in the framing of the law is perhaps largely due to our lethargy and apparent indifference. We are now confronted with its interpretation and proper application, and should not fail to give to the governmental authorities the benefit of our most serious consideration and competent advice. We are glad to be called into conference; and must willingly embrace the opportunity to aid in placing all interests involved on the most nearly equitable basis.

Then there is the ever-present and just now unusually inflamed antagonism between the employee and the employer. I know of no more promising work for engineers with their peculiar adaptation for studying the elements of a complicated situation, for determining the relative importance of its factors, for picking out the particular operating defects, and for suggesting solutions to difficulties. Conflicts generally arise through lack of mutual understanding and consequent lack of confidence. Where there is perfect understanding among fair-minded men there will be confidence; and where there is confidence, difficulties can be adjusted without strife. It seems to me that engineers may be of inestimable service to all classes by exerting the influence, which they undoubtedly possess, toward the education of each of the hostile elements as to the real necessities and actuating motives of the other. We are consumers; we are a portion of the public which always suffers in these industrial conflicts. We are coming to believe that no element in the community should be permitted to throw our entire industrial machine out of operation; that some control should and must be exercised to prevent these recurring disasters to the peace and prosperity of the country. The subject is one which demands the attention of all thoughtful and intelligent citizens and is to be settled, if at all, only by concerted effort.

In broader fields we see the need of engineering brains and attention in the worldwide control and distribution of mineral resources. Recent thoughtful discussions by Messrs. Leith and Spurr have shown us that the United States has important duties to its own people and to the people of other countries in connection with the commercial control of minerals. It will be generally admitted that, until very recently, our people have been so busy in developing our own resources that we have paid little attention to those of other countries. It is also a fact that our policy of insularity has tended to discourage investments abroad. The studies of world conditions which we have been forced to make within the past few years have made it clearly evident that we must wake up and protect ourselves and our industries in their relation to the raw materials for manufacture and worldwide distribution. Our resources must not be dominated by foreign capital and we must acquire our necessary share of those which can be controlled by us abroad. As Spurr wisely says:<sup>2</sup>

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<sup>2</sup> *The Scientific Monthly* (July, 1919) 80.

"Such mineral wealth as we possess in an exportable surplus must be managed for our best advantage. Such minerals as we do not possess in quantities sufficient for our own needs must be secured to us so far as possible by a definite and intelligent governmental policy."

Other governments have already passed laws debarring us from owning or operating oil-producing properties and mines of various sorts within their territories. We have done little or nothing along these important lines of security and protection for the future.

Finally, it is for us to remember that we are not only engineers but Americans; that "America is worth saving not only as a land in which men and women may be free and increasingly prosperous, but as a land and a government under which character can be built, individual capacity given opportunity for free exercise, and coöperation on the widest scale promoted not only for private advantage but for the public good."<sup>3</sup>

Let us not forget that "socialism is the twin brother of autocracy and, like autocracy, it is the deadly enemy of republicanism and of individual liberty." Let us stand firmly for the principles of equal rights and justice for all and have full confidence in the destiny of our country. Thus alone shall we live up to the full measure of our profession and our opportunities.

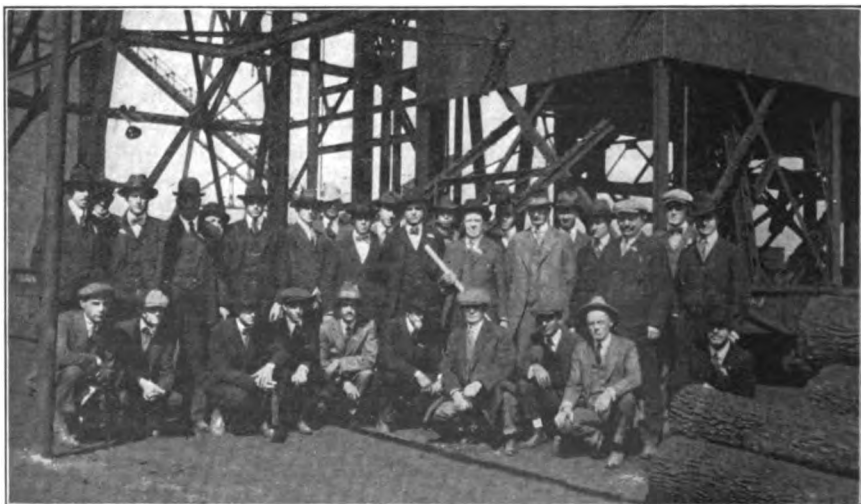
#### ALL-DAY EXCURSIONS

The only technical session on Thursday was a continuation of the Symposium on Pyrometry. The members not attending the symposium made the trip to La Salle. They were welcomed by the Mayor, to whose speech Major Arthur S. Dwight briefly responded. After luncheon the party divided and was taken by automobile to the various chosen points of interest, such as the cement works, the various zinc smelters, the coal mines, and underground cement-rock mines, where underground steam shovels were operating, etc. A special scenic trip was arranged for the ladies. The party returned by special train to Chicago, arriving at 7:30.

Those desiring to visit the coal mines at Franklin and Macoupin Counties left by train that evening on a special car for Benton, and were piloted through the field by Mr. Putnam, superintendent of the Old Ben Coal Corp'n., Mr. Carroll, assistant general superintendent of the Chicago, Wilmington & Franklin Coal Co., and Carl Scholz, general manager of the Vallier Coal Co. Through the courtesy of the various railroads the visitors were furnished a special coach which took them to the various mines with the least delay and enabled them to see more than would be otherwise possible. Mines 8 and 9 of the Old Ben Coal Corp'n., at West Frankfort, were first visited; thence the party proceeded to Orient mine of the Chicago, Wilmington & Franklin Coal Co., where luncheon was served, and then proceeded to Vallier, where both the top and the underground workings were inspected. The party returned to Benton and from there proceeded in automobiles to inspect the washery plant of the United States Fuel Co. at that point; and boarded the train reaching Chicago Saturday morning. Several left Benton for their homes without returning to Chicago.

<sup>3</sup> Nicholas Murray Butler. Address before Cincinnati Commercial Club, Apr. 19, 1919.

On Friday 110 people took the trip to North Chicago and Milwaukee. The train stopped at the Fansteel plant at North Chicago. Arriving at Milwaukee about 12:30, the party was entertained at luncheon by the Allis-Chalmers Co. in its club house. Afterwards the plant was visited. Two of the three ladies who accompanied the excursion were furnished a car by the Allis-Chalmers Co. to see the various points of interest in the city; the other lady preferred to remain with her husband and see the Allis-Chalmers plant. On the floor of the plant was mining machinery of all kinds that was to go to all parts of the world.



COAL EXCURSION PARTY AT ORIENT MINE.

#### CHAIRMEN OF COMMITTEES

It was a very strenuous week and a very successful meeting. The chairmen of the committees to whose labors this success was due are as follows: Ladies, Mrs. Chas. H. MacDowell; Finance, Carl Scholz; Publicity, F. G. Fabian; Papers, H. H. Stoek; Excursions, L. V. Rice; La Salle District, J. A. Ede; Industries, G. M. Davidson; Guides, F. W. DeWolf; Reception, Robert W. Hunt; Hotel, F. T. Snyder; Smoker Entertainment, C. W. Gennet, Jr.; Banquet, F. G. Fabian.

## PRESENT AT THE CHICAGO MEETING

- Abbott, Franklin E.  
 Adgate, Frank  
 Aertsen, G.  
 Aid, Kenneth  
 Albert, H. I.  
 Alexander, D. B. W.  
 Allan, Wm. G.  
 Allen, R. C.  
 Allen, Roy H.  
 Aller, Mr. and Mrs. F. D.  
 Altmayer, Maurice  
 Ambler, Harry A.  
 Ambrose, A. W.  
 Ammon, Mark A.  
 Ammon, Mr. and Mrs. Robt.  
 Anderson, George H.  
 Anderson, Mr. and Mrs. L. D.  
 Andros, S. O.  
 Appleby, W. R.  
 Archer, R. S.  
 Armitage, Paul  
 Arobb, Alden D.  
 Arthur, Walter  
 Ashman, A. O.  
 Atkinson, R. H.  
 Aupperle, J. A.  
 Austin, D. F.  
 Avery, G. E.
- Bailey, Mr. and Mrs. E. L.  
 Baird, R. E.  
 Baker, Robert Earl  
 Baldwin, A. T.  
 Baldwin, C. Kemble  
 Baldwin, Robert L.  
 Balke, Clarence W.  
 Bancroft, W. A.  
 Barbour, Percy E.  
 Barlow, R. E.  
 Barrett, Leslie P.  
 Barth, Kurt C.  
 Bash, F. E.  
 Bassett, W. M.  
 Bauer, Eugene C.  
 Baxter, Harold A.  
 Baxter, C. N.  
 Beardsley, A. W.  
 Beaver, Hugh T.  
 Beck, Wesley J.  
 Becker, Ralph C.  
 Bemis, P. F.  
 Beardsley, A. W.  
 Benedict, Mr. and Mrs. C. H.  
 Bennett, William H. K.  
 Bierbaum, Christopher H.  
 Bilharz, O. M.  
 Billow, Mr. and Mrs. E. E.  
 Black, Edward S.  
 Bleyer, Col. C. E.
- Boericke, Mr. and Mrs. W. F.  
 Bonnet, F. H.  
 Booth, Carl H.  
 Borchardt, Edmund R.  
 Bosworth, Harold O.  
 Bowie, C. P.  
 Boyle, C. L.  
 Boylston, Mr. and Mrs. H. M.  
 Brace, P. H.  
 Brassert, H. A.  
 Bray, Willis J.  
 Brazill, M. P., Jr.  
 Bretz, J. A.  
 Bright, Graham  
 Bristol, Wm. H.  
 Brokaw, A. D.  
 Bronson, C. B.  
 Brooks, G. S.  
 Brown, Edwin F.  
 Brush, Charley F.  
 Buck, Wilmer Earle  
 Buckley, Samuel S.  
 Buehler, H. A.  
 Bunzel, Erwin  
 Burchard, Ernest F.  
 Burgess, Geo. K.  
 Butler, P. B.
- Cain, J. R.  
 Cairns, Arthur L.  
 Calder, H. W.  
 Campbell, D. H.  
 Campbell, Mr. and Mrs. J. H.  
 Campion, Edward W.  
 Campion, Geo. B.  
 Carpenter, Alvin B.  
 Carpenter, A. G.  
 Carrier, Sam C.  
 Carroll, Walter  
 Carter, Fred E.  
 Carter, F. E.  
 Carter, Verne H.  
 Carus, Edward  
 Casselway, Lawrence O.  
 Cavender, John H.  
 Chamberlain, H. D.  
 Chambers, A. R.  
 Chaney, N. K.  
 Chapman, Mr. and Mrs. R. M.  
 Chappelle, Chas. W.  
 Claredge, E. T.  
 Clark, Frederick P.  
 Clark, Herbert A.  
 Clark, Horace H.  
 Clark, J. M.  
 Clayton, Chas. Y.  
 Clevenger, Galen H.  
 Clymer, I. L.
- Clymer, Mr. and Mrs. W. R.  
 Cobb, A. P.  
 Coghill, Will H.  
 Coho, H. B.  
 Coleman, M. S.  
 Cone, Edwin F.  
 Connor, M. F.  
 Cook, Oscar U.  
 Cook, S. J.  
 Cook, T. E.  
 Cooper, Harry S.  
 Copeland, F. K.  
 Copeland, F. W.  
 Corwin, C. O.  
 Cottrell, Fred. G.  
 Counselman, Mrs. Chas.  
 Cowin, Mr. and Mrs. Percy G.  
 Cox, G. H.  
 Crabtree, Fred  
 Crafts, Walter N.  
 Crane, Edward E.  
 Crane, Martin  
 Crosby, E. R.  
 Cunningham, J. B.  
 Cunningham, Lorain H.
- Dalbery, Mr. and Mrs. G. E.  
 Darlington, Homer T.  
 Davidson, Mr. and Mrs. G. M.  
 Davis, E. W.  
 Davis, Mr. and Mrs. John A.  
 Davis, Ralph E.  
 Davison, George L.  
 Dawe, C. Newman  
 Day, Edward B.  
 Deeds, D. D.  
 Deiffenbach, G. E.  
 Deiffenbach, Ernie E.  
 Deighton, Albert  
 De Long, B. H.  
 Delprat, G. D.  
 Demorest, D. J.  
 Denton, Warner A.  
 DeWolf, Mr. and Mrs. Frank W.  
 Dick, J. C.  
 Dickinson, A. W.  
 Dinamich, R. B.  
 Doennecke, H. W.  
 Doi, Kura  
 Dorr, J. V. N.  
 Douglas, Ross E.  
 Drew, C. V.  
 Dryer, T. B.  
 Dudley, Major Boyd, Jr.  
 Dudley, H. C.  
 Duggleby, A. F.

Dughton, Albert  
 Duncan, L. Grant  
 Duncan, M. M.  
 Dunn, W. L.  
 Dwight, Major and Mrs.  
 Arthur S.  
 Dwight, Mrs. J. S.  
 Dykewa, W. P.

Eagles, Reginald H.  
 Eavenson, Howard N.  
 Ebbert, Miss Georgia  
 Ebmeier, G. E.  
 Eckfeldt, J. J.  
 Ede, J. A.  
 Edwards, E. T.  
 Edwards, Victor E.  
 Eichenberger, R. W.  
 Elden, Wm. R.  
 Elliott, George K.  
 Elmendorf, Robert H.  
 Elmore, Guy H.  
 Engstrom, Mauritz  
 Erianbrack, H. E.  
 Ericson, Mr. and Mrs. Eric  
 John  
 Eulich, A. V.  
 Evans, D. R.

Fabian, Mr. and Mrs.  
 Francis G.  
 Fahlberg, E. David  
 Fahrenwald, F. A.  
 Fairchild, C. O.  
 Fairlie, A. M.  
 Faunce, George  
 Faragher, Paul V.  
 Farnham, S. W.  
 Farrell, Austin  
 Feild, Alexander L.  
 Ferguson, J. W.  
 Ferguson, W. G.  
 Fieldner, Arno C.  
 Filmer, E. A.  
 Fink, Mr. and Mrs. Colin  
 G.  
 Flynn, F. N.  
 Fobian, G. H.  
 Fohl, Wm. E.  
 Foo, H. T.  
 Foote, Paul D.  
 Forbes, C. R.  
 Force, H. J.  
 Foomis, André  
 Forrest, Chas. N.  
 Forsythe, W. E.  
 Foss, Mr. and Mrs. Fedor  
 F.  
 Franke, E. A.  
 Fraser, Mr. and Mrs.  
 Thomas  
 Freeman, John R., Jr.  
 French, Mr. and Mrs.  
 Burr J.  
 French, H. J.

Frey, H. C.  
 Freyn, Mr. and Mrs. H. J.  
 Fritch, G. M.  
 Frohman, E. D.  
 Fry, Lawford H.  
 Fuller, T. S.  
 Fulton, Charles H.  
 Fulton, J. S.  
 Fulweiler, W. H.

Galick, T. F.  
 Gardiol, A. D.  
 Gardner, E. D.  
 Gardner, G. N.  
 Gardner, Octavus D.  
 Gardner, R. S.  
 Garlichs, Herman  
 Carlock, Guy M.  
 Garnett, T. H.  
 Garratt, Frank  
 Gates, Arthur O.  
 Gath, Andrew L.  
 Gennet, Mr. and Mrs. C.  
 W., Jr.  
 George, H. C.  
 Gepp, H. W.  
 German, Howard M.  
 Gero, W. B.  
 Gillett, H. W.  
 Goldsmith, Osher  
 Gollert, N. H.  
 Goodale, Charles W.  
 Goodwin, L. H.  
 Goransson, Fredrik  
 Gottschalk, Mr. and Mrs.  
 V. R.  
 Grady, Kirby  
 Graham, E. R.  
 Graham, Walter F.  
 Grant, U. S., Dr. and Mrs.  
 Graton, L. C.  
 Gray, Arthur W.  
 Gray, F. W.  
 Griffiths, Mr. and Mrs. E.  
 P.  
 Grine, H. A.  
 Gudkov, V. T.  
 Guilford, Mr. and Mrs.  
 Darby S.

Halbing, J. E.  
 Haldeman, Geo. T.  
 Hall, Albert E.  
 Hall, Clarence A.  
 Hall, John H.  
 Hall, R. Dawson  
 Hall, W. S.  
 Hallingby, O.  
 Hamilton, A. K.  
 Hamilton, Frank C.  
 Hamilton, John P.  
 Hamilton, Orr R.  
 Hammill, Chester A.  
 Handy, Jas. O.  
 Handy, John A.

Hansell, W. V.  
 Hansen, C. A.  
 Hanson, Mr. and Mrs.  
 W. P.  
 Harder, Oscar E.  
 Harrison, T. R.  
 Harkness, W. E.  
 Harvey, F. A.  
 Hawkrige, Leslie D.  
 Hazlewood, Stuart  
 Hegeler, Julius W.  
 Hering, Carl  
 Herres, Otto  
 Hess, E. F.  
 Hess, Frank L.  
 Hickok, Charles N.  
 Hicks, R. E.  
 Hills, William M.  
 Hilsdale, Paul  
 Hinckley, A. T.  
 Hingston, E. C.  
 Hiroshi, Iwata  
 Hirschberg, E. S.  
 Hixon, H. G.  
 Hodge, John E.  
 Hoen, W. M.  
 Hoffman, R. B.  
 Hogaboom, George B.  
 Holland, A. A.  
 Hollis, H. L.  
 Holmes, L. A.  
 Holtzoff, H. C.  
 Holtman, Dudley F.  
 Hood, O. P.  
 Hooker, A. H. S.  
 Hoppock, Harland H.  
 Horton, L. B.  
 Hoskins, Wm.  
 Hotchkin, Harry  
 Hotchkin, Merritt W.  
 Hotchkiss, Mr. and Mrs.  
 W. O.  
 Howard, Clifford P.  
 Howard, Mr. and Mrs.  
 E. A.  
 Howard, L. E.  
 Howe, H. E.  
 Howe, Mr. and Mrs. Henry  
 M.  
 Howe, Raymond M.  
 Howendobler, John L.  
 Hoyt, Samuel L.  
 Huber, C. J.  
 Huff, Wilbert J.  
 Hulst, Mr. and Mrs. G. P.  
 Hultgren, Axel  
 Hummel, Carl B.  
 Huneke, A. J.  
 Hunt, Capt. and Mrs.  
 Robt. W.  
 Huston, Charles L.  
 Hyde, Edward P.  
 Hyde, Miss Jane  
 Hyde, Miss Jane E.  
 Ionides, Mr. and Mrs. S. A.

- Janitzky, Mr. and Mrs. Emanuel A.  
 Jewett, E. B.  
 Johann, H. A.  
 Johnson, G. E.  
 Johnson, H. W.  
 Johnston, Chas. W.  
 Johnstone, James O.  
 Jominy, Walter E.  
 Jones, Abner C.  
 Jones, Archibald  
 Jones, Thos. B.  
 Jordan, E. A.  
 Jordan, T. A.  
 Jorgenson, F. F.  
 Judd, Blake  
 Julihn, C. E.
- Katsuydma Katsujiro  
 Katzenstein, S. W.  
 Kelley, F. C.  
 Kelly, Mr. and Mrs. William  
 Kenney, E. F.  
 Kerwin, E. M.  
 Kiliani, R. B. T.  
 King, Arthur F.  
 Kirkpatrick, S. F.  
 Klugh, B. G.  
 Knight, E. C.  
 Knowles, A. S.  
 Knox, J. D.  
 Kraus, Edgar  
 Krejci, Milo W.  
 Kremers, H. C.  
 Kroenlein, Geo. A.
- Ladoo, Raymond B.  
 Lange, Mr. and Mrs. H. O.  
 Larson, C. W.  
 Larson, H. W.  
 Lawrence, Mr. and Mrs. H. Dudley  
 Laws, Mr. and Mrs. E. H.  
 Leach, Thomas W.  
 Leaver, Edmund S.  
 Leslie, Mr. and Mrs. E. H.  
 Levin, N. D.  
 Lewis, N. Y.  
 Liebig, Mr. and Mrs. John Orth  
 Lind, S. C.  
 Linforth, F. A.  
 Linville, Clarence P.  
 Lof, Eric A.  
 Longyear, Clyde S.  
 Longyear, John M., Jr.  
 Lowden, H. B.  
 Lowry, E. James  
 Lunt, Horace F.  
 Lynch, T. D.  
 Lyon, Dorsey A.
- MacCulloch, John Alex.  
 MacDowell, Mr. and Mrs. A. F.  
 MacFarland, H. B.  
 MacPherran, R. S.  
 McCadie, J. H.  
 McCaffery, Richard S.  
 McClush, W. J.  
 McComb, Wm. R.  
 McDonald, C. K.  
 McDowell, J. Spotts  
 McFarland, D. F.  
 McGirl, J. N.  
 McHugh, P. M.  
 McIntosh, Robert  
 McKee, Walter S.  
 McLeish, John  
 McLeod, Angus  
 McMillen, —  
 McMinch, William T.  
 M'Neile, W. K.  
 McNeill, W. K.  
 McQuigg, C. E.  
 McRae, Austin Lee  
 Maack, H. W.  
 Maas, Arthur R.  
 Macallum, A. B.  
 Mace, Mr. and Mrs. Clement H.  
 Mackay, G. M. J.  
 Maclay, Edgar G.  
 Macomb, Mr. and Mrs. J. DeN.  
 Magner, Dimitri  
 Mainwaring, H. H.  
 Mainwaring, W. D.  
 Malinovsky, A.  
 Malm, W. E.  
 Manegld, R. A.  
 Marble, G. E.  
 Marsh, Kirtland  
 Marsh, Mr. and Mrs. T. A.  
 Marsh, W. J.  
 Martin, Henry G.  
 Mathews, John A.  
 Mathews, J. H.  
 Mathewson, E. P.  
 Maynard, E. A.  
 Mead, W. J.  
 Meendt, Herbert Wm.  
 Meissner, C. A.  
 Metger, J. C.  
 Meyer, A. L.  
 Miller, A. H.  
 Miller, John James  
 Miller, W. B.  
 Mills, Louis D.  
 Miner, Harlan S.  
 Moeller, Franklin  
 Montoulieu, Mr. and Mrs. E. I.  
 Moore, Elwood S.  
 Moore, Philip N.  
 Moore, Richard B.  
 Moore, R. W.  
 Moore, Wm. E.
- Morris, Mr. and Mrs. John M.  
 Morris, H. T.  
 Moses, Mr. and Mrs. F. G.  
 Mueller, E. F.  
 Muller, Frank E.  
 Muren, A. L.  
 Murphy, Mr. and Mrs. Chas. J.  
 Murphy, Earle N.  
 Mylius, L. A.  
 Needham, Jas.  
 Nelson, John H.  
 Newberry, Andrew W.  
 Newkirk, E. D.  
 Newman, M. H.  
 Newton, William, Jr.  
 Nichols, Mr. and Mrs. Henry W.  
 Nitchie, Mr. and Mrs. Charles C.  
 Noon, Roderick T.  
 Nordale, C. E.  
 Norris, Miss Esther  
 Norris, George L.  
 Norris, Miss Jane  
 Norris, R. V.  
 Northrup, Edwin F.  
 Northrup, Harry B.  
 O'Brien, Mr. and Mrs. T. H.  
 Oberg, A. C.  
 O'Connell, E. J.  
 Oda, Fumie  
 Ogelsby, J. Young  
 Ogg, W. A.  
 Osgood, Samuel W.  
 Ovitz, F. K.  
 Oyles, W. F.  
 Park, Morey A.  
 Parker, Edward W.  
 Parker, L.  
 Parmelee, H. C.  
 Parr, S. W.  
 Patrick, R. M.  
 Paul, J. W.  
 Payne, Henry L.  
 Peigh, Willard S.  
 Penwell, Louis  
 Perrine, Irving  
 Peterman, A. E.  
 Peters, Mr. and Mrs. M. F.  
 Petsch, A. H.  
 Phalen, W. C.  
 Picher, O. S.  
 Pickens, A. C.  
 Pilling, Norman B.  
 Pitkin, S. H.  
 Plumb, A. M.  
 Polhemus, T.  
 Pomeroy, W. N.  
 Porter, Horace C.  
 Potts, Allen D.  
 Powell, Alfred R.

- Powell, Lt. P. W.  
 Price, James L.  
 Priestley, W. J.  
 Prochazka, J. A.  
 Pulsifer, H. B.  
 Putnam, W. P.
- Quigley, W. S.
- Rackett, Gerald F.  
 Rakowsky, Victor  
 Ralston, Oliver C.  
 Ramsey, E. R.  
 Rand, Charles F.  
 Randall, M. S.  
 Rascovich, M. B.  
 Rayner, Geo. W.  
 Read, J. Buries  
 Read, Thomas T.  
 Ready, Virgil E.  
 Reeder, E. C.  
 Reid, G. H.  
 Reid, J. W.  
 Reigart, John R.  
 Repetti, G. W.  
 Reutschi, Rudolph  
 Rhodes, J. B.  
 Rice, Calvin H.  
 Rice, Geo. S.  
 Rice, Mr. and Mrs. Luther V.  
 Richards, Joseph W.  
 Riddell, Joseph Murray  
 Riddell, Wallace C.  
 Rigg, Gilbert  
 Roberts, B. J.  
 Roberts, Keith  
 Roberts, Milnor  
 Roberts, Miss  
 Robertson, F. D. S.  
 Robertson, J. D.  
 Robinson, J. W.  
 Rogers, W. R.  
 Rollason, Geoffrey M.  
 Royster, P. H.  
 Ruder, W. E.  
 Ruiz, Ricardo  
 Rush, Butler  
 Ruth, Joseph P.  
 Rutherford, Forest  
 Ryan, F. J.  
 Ryder, H. M.  
 Rys, C. F. W.
- Saunders, Walter M.  
 Schappler, Rudolph C.  
 Scholowsky, Ignace  
 Scholz, Mr. and Mrs. Carl  
 Schultz, Roy Wilson  
 Schumacher, L. B.  
 Schwab, C. M.  
 Schwartz, Mr. and Mrs. Harry  
 Schwarz, Charles E.  
 Scott, E. Kilburn  
 Scott, Howard  
 Scott, Lester C.
- Seaman, H. W.  
 Seaman, Wilfred A.  
 Sedwick, T. D.  
 Seede, John A.  
 Seiter, J. Earl  
 Seyl, P. C.  
 Shackelford, Benj. E.  
 Shackelford, Mr. and Mrs. W. B.  
 Shanfeld, Samuel Norman  
 Shannon, C. W.  
 Sharp, Aileen Grace  
 Sharp, John R.  
 Shaw, H. L.  
 Shaw, R. A.  
 Sheldae, E. L.  
 Shepherd, B. F.  
 Sherman, Ben E.  
 Shimer, W. R.  
 Shlandeman, Frank  
 Shuman, Jesse J.  
 Siebenthal, Claude E.  
 Silverman, Alexander  
 Simpson, George N.  
 Simpson, Gerald R.  
 Singfield, J. H.  
 Skagerberg, Lt. R.  
 Skinkle, W. B.  
 Skowronski, S.  
 Slaughter, B. G.  
 Slover, Edwin Allsop  
 Small, Harry H.  
 Small, Major Sidney S.  
 Smirnoff, Theodor V.  
 Smith, Cecil Weldon  
 Smith, Cloyde M.  
 Smith, Henry B.  
 Smith, H. I.  
 Smith, Mrs. Ida B.  
 Smith, M. B.  
 Smith, Richard A.  
 Snelling, Mr. and Mrs. Walter O.  
 Snider, L. C.  
 Snyder, Mr. and Mrs. F. T.  
 Snyder, H. R.  
 Sosman, R. B.  
 Sowder, Stanley  
 Speller, F. N.  
 Spen, F. W.  
 Spencer, C. A.  
 Spencer, Frank N.  
 Sperr, F. W.  
 Sperr, J. Dana  
 Spicer, H. N.  
 Spickard, H. E.  
 Spilsbury, E. Gybbon  
 Spofford, Charles Byron, Jr.  
 Spring, Mr. and Mrs. LaVerne W.  
 Stack, J. R.  
 Stadelman, E. S.  
 Staehle, A. M.  
 Stedman, W. A.  
 Stevens, Thos. A.
- Stevens, W. L.  
 Stevenson, W. L.  
 Stewart, E. P.  
 Stimpson, C. W.  
 Stockwell, Mr. and Mrs. R. K.  
 Stoek, H. H.  
 Stolte, F. E.  
 Stone, Wm. H.  
 Stoner, Oscar E.  
 Stoughton, Bradley  
 Strang, E. S.  
 Street, L. G.  
 Stronck, H. N.  
 Strong, Ronald T.  
 Stuart, Quin W.  
 Stubbs, R. N.  
 Styri, Haakon  
 Sugimura, Ihei  
 Suser, Max  
 Suverkrop, E. A., Jr.  
 Suzuki, Masao  
 Swart, Walter G.  
 Swayze, R. O.  
 Swift, C. C.  
 Swigart, T. E.
- Tada, Yoshūchi  
 Tao, H. L.  
 Taylor, Mr. and Mrs. George M.  
 Taylor, John C.  
 Taylor, Sam'l A.  
 Taylor, T. S.  
 Tellam, Mr. and Mrs. Alfred  
 Terrell, Mr. and Mrs. A. D.  
 Terry, M. L.  
 Thatcher, Arthur  
 Thayer, Mr. and Mrs. W. W.  
 Thiessen, Reinhardt  
 Thill, J. R.  
 Thoenen, J. R.  
 Thoms, J. E.  
 Thomas, Kirby  
 Thornberry, Martin Har-  
 mon  
 Thum, Mr. and Mrs. E. E.  
 Thunston, L. S.  
 Tone, F. J.  
 Tont, E.  
 Torbert, A. C.  
 Toublet, Lt. Comm. and Mrs. George  
 Tour, S.  
 Townsend, G. C.  
 Trager, Mr. and Mrs. Earl A.  
 Tratman, E. E. R.  
 Treat, F. H.  
 Trumbull, H. N.  
 Trump, Edward N.  
 Turner, Mr. and Mrs. Scott  
 Twomey, L. S.

|                                  |                              |                                |
|----------------------------------|------------------------------|--------------------------------|
| Udy, Marvin J.                   | Washburne, Chester W.        | Wohlrab, A. H.                 |
| Umbriet, Stanton                 | Waterhouse, G. B.            | Wolf, Harry J.                 |
| Underwood, Mr. and Mrs. J. R.    | Weaver, O. M.                | Wolfe, Albert H.               |
| Unger, J. S.                     | Webb, Albert Loomis          | Wolff, E. H.                   |
| Unger, M.                        | Webster, F. L.               | Woodale, C. E.                 |
| Upthegrove, Clair                | Webster, Mr. and Mrs. Ronald | Worthing, A. G.                |
| Uthoff, Fred W.                  | Webster, W. R.               | Wray, D. C.                    |
|                                  | Weidman, S.                  | Wright, C. A.                  |
| Valentine, I. R.                 | Weigel, W. M.                | Wright, Percy E.               |
| Van Arsdale, Wm. H.              | Weiser, Franklin S.          | Wysor, Henry                   |
| Van Eman, Mr. and Mrs. Andrew G. | Wemple, Leland E.            |                                |
| Van Horn, Irving H.              | Wettstein, Thomas F.         | Yancey, H. F.                  |
| Vanick, James S.                 | Weymouth, F. A.              | Yardley, John L.               |
| Van Tassel, W. N.                | Wheeler, C. E.               | Yeager, H. M.                  |
| Vesey, L. E.                     | Wheeler, H. E.               | Yensen, T. D.                  |
| Vigneau, Jos. J.                 | White, Eynon S.              | Yoder, C. P.                   |
| Voldmann, Henry                  | White, R. E.                 | Young, C. M.                   |
| Vom Baur, C. H.                  | White, R. H.                 | Young, Mr. and Mrs. E. B.      |
|                                  | Wilder, Erskine P.           | Young, E. R., Jr.              |
| Wahl, Henry R.                   | Wilkinson, Howard P., Jr.    | Young, Mr. and Mrs. Herbert W. |
| Walker, E. W.                    | Williamson, C. S., Jr.       | Young, Mr. and Mrs. Howard J.  |
| Wallower, Mr. and Mrs. Frank C.  | Williamson, F. O.            | Young, Ralph A.                |
| Walsh, H. T.                     | Wilson, Alfred W. G.         |                                |
| Walsh, Thomas P.                 | Wilson, George Bennett       |                                |
| Ward, Howard R.                  | Wiltbank, Dr. R. T.          | Zabel, W. P.                   |
| Warford, Mr. and Mrs. W. L.      | Winchell, A. N.              | Zapffe, Carl                   |
|                                  | Winchell, Mr. and Mrs. H. V. | Zern, E. N.                    |
|                                  | Winder, C. A.                | Zimmermann, A. G.              |

#### A. I. M. E. COMMITTEE ON MINE TAXATION

At the request of representatives of the Treasury Department, President Winchell appointed the following committee, which held a two-day conference with the Treasury representatives in Washington on Oct. 6 and 7 to aid in deciding upon the principles of mine taxation to be adopted by the Government. The results of this conference, which is not yet concluded, will be published in a future *Bulletin*.

|                 |  |            |   |
|-----------------|--|------------|---|
| Coal            | { R. V. NORRIS<br>F. S. PEABODY<br>S. A. TAYLOR                          | General    | { R. C. ALLEN<br>J. R. FINLAY<br>J. F. CALLBREATH<br>H. V. WINCHELL |
| Iron            | { R. M. BENNETT<br>W. G. SWART<br>W. G. MATHER                           | Law        | { C. F. KELLEY<br>JOHN P. GRAY<br>PAUL ARMITAGE                     |
| Copper          | { WALTER DOUGLAS<br>R. L. AGASSIZ<br>J. PARKE CHANNING<br>D. C. JACKLING | Oil*       | { WILLIAM A. WILLIAMS   |
| Gold and Silver | { F. L. GARRISON<br>WALTER FITCH, SR.<br>J. E. SPURR                     | Accounting | { JUDD STEWART<br>H. T. VAN ELLS<br>GEORGE F. WOLFF                 |
| Lead and Zinc   | { H. A. GUESS<br>J. L. BRUCE<br>ARTHUR THACHER                           |            |   |

\*This matter has already been thoroughly canvassed.

## TECHNICAL SESSIONS

*Mine Taxation*

On Monday morning, Sept. 22, a session on Mine Taxation was held in coöperation with the Internal Revenue Dept., U. S. Treasury, Mr. R. C. Allen presiding. This was followed by two adjourned sessions, at which Mr. R. C. Allen and Mr. A. D. Brokaw presided. The following paper was presented:

Federal Taxation of Mines. By L. C. Graton. (Presented by the author; discussed by R. V. Norris, W. O. Hotchkiss, W. P. Beldon, Paul Armitage, R. C. Allen, E. F. Brown, William Kelly, A. D. Brokaw, F. W. Sperr, C. H. Benedict, E. P. Griffiths, W. E. Forsythe, and the author.)

*Coal and Gas*

The first session on Coal and Gas was held on Monday morning, Sept. 22; the second, on the afternoon of the same day. Mr. Carl Scholz presided at both sessions. The following papers were presented:

Research on the Coal-mining Industry. By E. A. Holbrook. (Presented by the author.)

Some Factors that Affect the Washability of a Coal. By Thomas Fraser and H. F. Yancey. (Presented by the author.)

A Use Classification of Coal. By George H. Ashley. (Presented by title.)

Distribution of Anthracite. By A. S. Learoyd. (Presented by title.)

Height of the Gas Cap in the Safety Lamp. By C. M. Young. (Presented by the author.)

Engineering Features of Modern Large Coal Mines in Illinois and Indiana. By C. A. Herbert and C. M. Young. (Presented by the authors.)

Gas-producer Practice. By G. S. Brooks and C. C. Nitchie. (Presented by the authors.)

Testing of Coals for Byproduct Coking and Gas Manufacture. By Horace C. Porter. (Presented by the author.)

Coals of Ohio and their Limitations for Byproduct Coke. By Wilber Stout. (Presented by the author.)

Outdoor Substations in Connection with Coal-mining Installations. By H. W. Young. (Presented by the author.)

*Non-ferrous Metallography*

The session on Non-ferrous Metallography was held at 11 A.M. on Monday, Sept. 22, Mr. G. M. Fritch presiding. The papers at this meeting were all presented by title only to afford opportunity for discussion. The same papers were presented at the meeting of the Institute of Metals Division in Philadelphia, Sept. 29-Oct. 2, and the list of titles will be found in the account of the Proceedings of that meeting, p. xxiii.

*Geology*

On Monday afternoon, Sept. 22, a session on Geology was held, Prof. A. N. Winchell presiding. The following papers were presented:

Chrome-ore Deposits in Cuba. By Ernest F. Burchard. (Presented by the author.)

Recent Studies of Domestic Chromite Deposits. By J. S. Diller. (Presented by the author.)

Manganese-ore Deposits in Cuba. By Ernest F. Burchard. (Presented by the author.)

Correlation of the Formations of the Huronian Group in Michigan. By R. C. Allen. (Presented by the author.)

- Mud Volcanoes in Colombia. By Stanley C. Herold. (Presented by title.)  
 Magnesite; its Geology, Products and their Uses. By C. D. Dolman. (Presented by title.)  
 Titaniferous Iron Sands of New Zealand. By V. W. Aubel. (Presented by title.)  
 Recent Studies of Domestic Manganese Deposits. By E. C. Harder and D. F. Hewett. (Presented by title.)

### *Milling and Industrial Organization*

A session on Milling and Industrial Organization was held on Monday, Sept. 22, at 2 P.M., Mr. F. K. Copeland presiding. The following papers were presented:

- Chilean-mill Practice at the Portland Mill. By Luther W. Lennox. (Presented by the author.)  
 Graphic Metallurgical Control. By H. M. Merry. (Presented by title.)  
 Mill Operations at the United Eastern during 1917-1918. By Wheeler O. North. (Presented by title.)  
 Crushing Practice at New Cornelia Copper Co. By W. L. Du Moulin. (Presented by title.)  
 Method of Curtailing Forces at the Copper Queen. By Charles F. Willis. (Presented by title.)  
 Educational Methods at the Copper Queen. By Charles F. Willis. (Presented by title.)  
 Physical Examination Previous to Employment. By Charles F. Willis. (Presented by title.)

### *Iron and Steel*

There were three sessions on Iron and Steel. At the meetings on Tuesday afternoon and Wednesday morning, Prof. J. W. Richards presided; at the session on Tuesday evening, Mr. Horace V. Winchell was the presiding officer. The following papers were presented:

- Blast-furnace Refractories. By Raymond M. Howe. (Presented by the author.)  
 Effervescing Steel. By Henry D. Hibbard. (Presented by title.)  
 Aircraft Steels. By Albert Sauveur. (Presented by title.)  
 Determining Gases in Steel and the Deoxidation of Steel. By J. R. Cairr. (Presented by the author.)  
 Effect of Time and Low Temperature on Physical Properties of Medium-carbon Steel. By G. A. Reinhardt and H. L. Cutler. (Presented by title.)  
 Erosion Tests of Rifle Barrels. By A. E. Bellis. (Presented by title.)  
 Metallography of Rifle-barrel Steel. By G. F. Butterworth. (Presented by title.)  
 Industries of the Chicago District. By T. W. Robinson. Lantern slides, etc. (Presented by the author.)  
 Manufacture of Steel Rails. By Robert W. Hunt. (Presented by the author.)  
 The World's Largest Plate Mill. By C. L. Huston. (Presented by the author.)  
 Cooling Properties of Technical Quenching Liquids. By N. B. Pilling and T. D. Lynch. (Presented by the authors.)  
 Differential Crystallization in Cast-steel Runner. By Francis B. Foley. (Presented by the author.)  
 Manufacture and Properties of Light-wall Structural Tubing. By H. J. French. (Presented by the author.)  
 Oxygen in Cast Iron and its Application. By Wilford L. Stork. (Presented by the author.)  
 Graphitization of White Cast Iron upon Annealing. By Paul D. Merica and L. J. Gurevich. (Presented by title.)  
 Experimental Data Obtained on Charpy Impact Machine. By F. C. Langenberg. (Presented by title.)  
 Heat Treatment of Cast Steel. By John H. Hall, Arvid E. Nissen and Knox Taylor. (Presented by the authors.)  
 \* Deep Etching of Rails and Forgings. By F. M. Waring and K. E. Hofamann. (Presented by title.)

\* Presented at the June, 1919, meeting of the American Society for Testing Materials, and read here only to afford opportunity for discussion.

*Oil*

A session on Oil was held on Tuesday evening, Sept. 23, Mr. C. W. Washburne presiding. The following papers were presented:

- Irvine Oil District, Kentucky. By Stuart St. Clair. (Presented by the author.)
- Petroliferous Provinces. By E. G. Woodruff. (Presented by title.)
- Investigations Concerning Oil-water Emulsion. By A. W. McCoy, H. R. Shidel and E. A. Trager. (Presented by Mr. Trager.)
- Essential Factors in Valuation of Oil Properties. By Carl H. Beal. (Presented by title.)
- Application of Law of Equal Expectations to Oil Production in California. By Carl H. Beal and E. D. Nolan. (Presented by title.)
- Value of American Oil-shales. By Charles Baskerville. (Presented by title.)

*Sulfur in Coal*

Two sessions were held on Sulfur in Coal, on Wednesday morning and Wednesday afternoon, Sept. 24. Prof. H. H. Stoek presided at both sessions. Papers were presented as follows:

- Geographic Distribution of Sulfur in the West Virginia Coal Beds. By I. C. White. (Presented by the author.)
- Occurrence and Origin of Finely Disseminated Sulfur Compounds in Coal. By Rheinhardt Thiessen. Illustrated by lantern slides. (Presented by the author.)
- Mechanical Separation of Sulfur Minerals from Coal. By J. R. Campbell. (Presented by the author.)
- Sulfur in Coal—Geological Aspects. By George H. Ashley. (Presented by title.)
- Forms in Which Sulfur Occurs in Coal. By A. R. Powell and S. W. Parr. (Presented by title.)
- Effect of Sulfur in Coal used in Ceramic Industries. By C. W. Parmelee. (Presented by title.)
- Removal of Sulfur from Illuminating Gas. By W. W. Odell and W. A. Dunkley. (Presented by title.)
- Low Sulfur Coal in Pennsylvania. By H. M. and T. M. Chance. (Presented by the author.)
- Low-sulfur Coals of Kentucky. By Willard R. Jillson. (Presented by title.)
- Low-sulfur Coal in Illinois. By Gilbert H. Cady. (Presented by title.)
- Sulfur in the Coking Process. By S. W. Parr. (Presented by title.)
- Commercial Recovery of Pyrite from Coal. By S. H. Davis. (Presented by title.)
- Sulfur in Producer Gas. By F. Crabtree and A. R. Powell. (Presented by title.)

*Mining and Local Resources*

A session on Mining and Local Resources was held on Wednesday morning, Sept. 24. Mr. F. W. DeWolf presided. The following papers were presented:

- Wisconsin Zinc District. By W. F. Boericke and T. H. Garnett. (Presented by the authors.)
- Mineral Resources of the La Salle District. By J. A. Ede. (Presented by the author.)
- New Angles to the Apex Law. By John A. Shelton. (Presented by the author.)
- Mining Methods of Alaska Gastineau Mining Co. By G. T. Jackson. (Presented by title.)
- Tunnel Driving at Copper Mountain, B. C. (Columbia Section Paper). By Oscar Lachmund. (Presented by title.)
- Geology and Mining Methods at Pilares Mine. By W. Rogers Wade and Alfred Wandtke. (Presented by title.)
- Wedging Diamond-drill Holes. By O. Hall and V. P. Row. (Presented by title.)

*Non-ferrous Metallurgy*

On Wednesday afternoon, Sept. 24, a joint session with the American Electrochemical Society was held, on the subject of Non-ferrous Metal-

lurgy. Mr. E. P. Mathewson presided. Papers were presented as follows:

Electric-resistance Furnace of Large Capacity for Zinc Ores. By Charles H. Fulton. (Presented by the author.) Illustrated by lantern slides.

Water and Chlorides in Cement Copper Briquettes. By Edward Keller. (Presented by title.)

Chemical and Electrochemical Problems Involved in New Cornelia Copper Company's Leaching Process. By Henry S. MacKay. (Presented by title.)

Electrolytic Zinc. By C. A. Hansen. (Presented by title.)

Treating Antimony Ores. By George P. Hulst. (Presented by the author.)

### *Pyrometry\**

A session on Pyrometry with Special Reference to Iron and Steel Metallurgy was held on Wednesday afternoon, Sept. 24, at which Dr. G. K. Burgess presided and the following papers were presented:

Report of Pyrometer Committee of National Research Council. By George K. Burgess. (Presented by the author.)

Pyrometry in Blast-furnace Work. By P. H. Royster and T. L. Joseph. (Presented by the authors.)

Pyrometry and Steel Manufacture. By A. H. Miller. (Presented by the author.)

Electric, Open-hearth and Bessemer Steel Temperatures. By F. E. Bash. (Presented by the author.)

Some Thermal Relations in the Treatment of Steel. By Charles F. Brush. (Presented by the author.) Illustrated by lantern slides.

Pyrometry in the Tool Manufacturing Industry. By J. V. Emmons. (Presented by the author.)

Forging Temperatures and Rate of Heating and Cooling of Large Ingots. By F. E. Bash. (Presented by the author.)

The second session on Pyrometry was held on Thursday, Sept. 25, beginning at 10 a.m. Dr. Burgess presided and the following papers were presented:

Temperature. By J. S. Ames. (Presented by title.)

Standard Scale of Temperature. By C. W. Waidner, E. F. Mueller and Paul D. Foote. (Presented by the authors.)

Metals for Pyrometer Standardization. By C. W. Waidner and George K. Burgess. (Presented by the authors.)

Fundamentals of Pyrometry. By C. E. Mendenhall. (Presented by the author.)

Thermoelectric Pyrometry. By Paul D. Foote, T. R. Harrison and C. O. Fairchild. (Presented by the authors.)

Potentiometers for Thermoelement Work. By W. P. White. (Presented by title.)

Self-checking Galvanometer Pyrometer. By H. F. Porter. (Presented by the author.)

Some Factors Affecting the Usefulness of Base-metal Thermocouples. By O. L. Kowalke. (Presented by the author.)

Tables and Curves for Use in Measuring Temperatures with Thermocouples. By L. H. Adams. (Presented by the author.) Illustrated by lantern slides.

Reference Standard for Base-metal Thermocouples. By N. E. Bonn. (Presented by title.)

Alloys Suitable for Thermocouples and Base-metal Thermoelectric Practice. By J. M. Lohr. (Presented by title.)

Recent Improvements in Pyrometry. By R. P. Brown. (Presented by the author.)

Automatic Compensation for Cold-Junction Temperature of Thermocouple Pyrometers. By F. Wunsch. (Presented by title.)

Hot Wire Anemometer with Thermocouple. By T. S. Taylor. Illustrated by lantern slides. (Presented by the author.)

Porcelain for Pyrometric Purposes. By F. H. Riddle. (Presented by the author.)

Pyrometer Porcelains and Refractories. By R. W. Newcomb. (Presented by title.)

\*In cooperation with the National Research Council and the U. S. Bureau of Standards.

- Porcelain Pyrometer Protecting Tubes. By F. A. Harvey. (Presented by the author.) Illustrated by lantern slides.
- Protecting Tubes for Thermocouples. By R. B. Lincoln. (Presented by title.)
- Melting Point of Refractory Materials. By Leo I. Dana. (Presented by title.)
- High Temperature Scale and its Application in the Measurement of True, Brightness and Color Temperature. By Edward P. Hyde. (Presented by the author.)
- Theory and Accuracy in Optical Pyrometry with Particular Reference to the Disappearing-filament Type. By W. E. Forsythe. (Presented by the author.) Illustrated by lantern slides.
- Optical and Radiation Pyrometry. By Paul D. Foote and C. O. Fairchild. (Presented by the authors.)
- Industrial Application of the Disappearing-filament Type of Optical Pyrometers. By F. E. Bash. (Presented by the author.)
- Use of the Optical Pyrometer for Control of Optical-glass Furnaces. By C. N. Fenner. (Presented by title.)
- Emissive Powers and Temperatures of Non-black Bodies. By A. G. Worthing. (Presented by the author.) Illustrated by lantern slides.
- Recording Thermocouple Pyrometers. By Leo Behr. (Presented by title.)
- Recording Pyrometry. By C. O. Fairchild and Paul D. Foote. (Presented by the authors.)
- High-temperature Control. By C. O. Fairchild and Paul D. Foote. (Presented by the authors.)
- Resistance Thermometry. By F. W. Robinson. (Presented by title.)
- Tin; an Ideal Pyrometric Material. By E. F. Northrup. (Presented by the author.)
- Resistance Thermometry for Industrial Use. By Charles P. Frey. (Presented by title.)
- Thermocouple Installation in Annealing Kilns for Optical Glass. By E. D. Williamson and H. S. Roberts. (Presented by the authors.)
- Annealing of Glass. By A. Q. Tool and J. Valasek. (Presented by title.)
- Pyrometry Applied to Bottle-glass Manufacture. By R. L. Frink. (Presented by the author.)
- Pyrometry in the Manufacture of Optical Glass. By Albert J. Walcott. (Presented by the author.)
- Pyrometry as Applied to the Manufacture of Optical Glass. By Carl W. Keuffel. (Presented by title.)
- Pyrometer Shortcomings in Glass-house Practice. By W. M. Clark and Charles D. Spencer. (Presented by the authors.)
- Pyrometry in Manufacture of Clay Wares. By F. K. Pence. (Presented by the author.)
- Application of Pyrometry to the Manufacture of Gas-mask Carbon. By K. Marsh. (Presented by the author.) Illustrated by lantern slides.
- Pyrometry in the Ceramic Industries. By C. B. Thwing. (Presented by the author.)
- Pyrometry in Rotary Portland Cement Kilns. By Leo I. Dana and C. O. Fairchild. (Presented by title.)
- Pyrometry in the Ceramic Industry. By John P. Goheen. (Presented by the author.)
- Temperatures of Incandescent Lamp Filaments. By Benjamin E. Shackelford. (Presented by the author.) Illustrated by lantern slides.
- Temperature Measurements of Incandescent Gas Mantles. By H. E. Ives. (Presented by title.)
- Applications of Pyrometry to Problems of Lamp Design and Performance. By I. H. Van Horn. (Presented by the author.) Illustrated by lantern slides.
- Use of Modified Rosenhain Furnace for Thermal Analysis. By H. Scott and J. R. Freeman, Jr. (Presented by title.)
- High Temperature Thermometers. By R. M. Wilhelm. (Presented by title.)
- Temperature of a Burning Cigar. By T. S. Sligh and H. R. Kraybill. (Presented by title.)
- Teaching Pyrometry in our Technical Schools. By George V. Wendell. (Presented by title.)
- Teaching Pyrometry in Technical Schools. By C. E. Mendenhall. (Presented by the author.)
- Teaching Pyrometry. By O. L. Kowalke. (Presented by the author.)
- Present Status of Radiation Constants. By W. W. Coblentz. (Presented by the author.)
- Pyrometer Protection Tubes. By Otis Hutchins. (Presented by the author.)

# PROCEEDINGS OF THE ONE HUNDRED AND TWENTY-FIRST MEETING, PHILADELPHIA

The meeting of the Institute of Metals Division was held in Philadelphia from Sept. 30 to Oct. 2, inclusive. On Monday evening preceding the meeting, a dinner was held at the Ritz-Carlton Hotel at which many of the former officers of the Division and of the present officers and executive committee were present. The subject of a membership committee was discussed and a motion to appoint such a committee with powers to go over the membership list for the selection of divisional members and to institute plans for additional members was passed. Mr. H. E. Howe and Dr. Johnston of the National Research Council attended the meeting and presented their plans for an Alloys Research Association. Many opinions were voiced as to the practicability of such a scheme and Mr. Howe expressed himself in appreciation of the coöperative thought and efforts given him.

On Tuesday morning the Institute of Metals Division joined sessions with the American Foundrymen's Association and listened to the opening addresses. In the afternoon a boat ride was taken on the Delaware River, visiting the plants of the Cramp Ship and Engine Building Co. and the shipyard of the Emergency Fleet Corp'n. at Hog Island. The launching of the boat christened "Afoundria" at 5 p.m. was witnessed by members of the party.

The opening technical session was held on Tuesday evening at the Ritz-Carlton Hotel at 8 o'clock. The next session was held at the Ritz-Carlton at 10 o'clock on Wednesday morning and the final session at the same time and place on Thursday morning. The sessions were well attended and the discussion was good. The highly technical nature of some of the papers on the program was of special note. Taken as a whole the meeting was one of the most successful ever held. The following papers were presented:

- Manufacture and Electrical Properties of Manganin. By F. E. Bash.
- Grain Growth in Alpha Brass. By F. G. Smith. Illustrated by lantern slides.
- Five Foundry Tests of Zinc Bronzes. By C. P. Karr.
- Manufacture and Electrical Properties of Constantan. By F. E. Bash.
- Tin Fusible Boiler Plug Manufacture and Testing. By L. J. Gurevich and J. S. Hromatko.
- Heat Treatment of Aluminum Alloy Castings. By Zay Jeffries and W. A. Gibson.
- Influence of Heat Treatment on Gun Metal. By C. F. Smart.
- Deterioration of Nickel Spark-plug Terminals in Service. By Henry S. Rawdon and A. I. Krynitzy.
- Heat Treatment of Duralumin. By Paul D. Merica, R. G. Waltenberg and H. Scott.
- Mechanical Properties and Resistance to Corrosion of Rolled Light Alloys of Aluminum and Magnesium with Copper, Nickel and Manganese. By Paul D. Merica, R. G. Waltenberg and A. N. Finn.
- Simplification of Inverse-rate Method for Thermal Analysis. By Paul D. Merica.
- Constitution and Metallography of Aluminum and its Light Alloys with Copper and with Magnesium. By Paul D. Merica, R. G. Waltenberg and J. R. Freeman, Jr.
- Some Properties and Applications of Rolled Zinc Strip and Drawn Zinc Rod. By C. H. Mathewson, C. S. Trewin and W. H. Finkeldey.
- Physical Properties of Certain Lead-zinc Bronzes. By Homer F. Staley and C. P. Karr.
- Physical Properties of Nickel. By David H. Browne and John F. Thompson.

## PRESENT AT THE PHILADELPHIA MEETING

|                               |                              |                      |
|-------------------------------|------------------------------|----------------------|
| Antisell, F. L.               | Kaufman, E. C.               | Snyder, Chas. G.     |
| Bassett, Geo. B.              | Keefe, John J.               | Stokesbury, Chas. H. |
| Bassett, Mr. and Mrs. W. H.   | Keefe, Marie C.              | Stoughton, Bradley   |
| Bergman, Adolph               | Keefe, Mrs. Phoebe           | Thompson, J. F.      |
| Braccher, P. S.               | Keshion, H. G.               | Thum, E. E.          |
| Bragg, C. T.                  | Klinck, F. E.                | Vickers, Charles     |
| Braid, Mr. and Mrs. Arthur T. | Kofke, Harry C.              | Wallace, Robt. S. B. |
| Brown, John T.                | Langsenkamp, Wm.             | Welsh, Mrs. Wm.      |
| Burgess, Geo. K.              | Lasier, E. L.                | Williams, Karl D.    |
| Clamer, G. H.                 | Mac Pherran, R. S.]          | Wolf, Fred L.        |
| Corse, W. M.                  | McKinney, P. E.              | Wood, R. A.          |
| Cowan, Mr. and Mrs. Wm. A.    | McNamara, J. F.              | Wood, Robert F.      |
| Crowe, Mr. and Mrs. John J.   | Mathewson, C. H.             | Wray, C. F.          |
|                               | Merica, Paul D.              |                      |
|                               | Merrill, Alden               |                      |
|                               | Merriman, Mr. And Mrs. T. C. | Visitors             |
| Davidson, Philip              | Messmer, Ferd                | Bahr, F. C.          |
| Dickson, Walter S.            | Oberderfer, Jonas L.         | Basch, D.            |
| Dittman, Matthew C            | Olson, L. W.                 | Bassett, Robert S.   |
| Dittman, Rehfuß.              | Price, Wm. B.                | Battelle, J. G.      |
| Finkeldey, Wm. H.             | Quigley, W. S.               | Bedworth, Robert E.  |
| Frank, Wm. K.                 | Reardon, W. J.               | Dittman, Mrs. Rehfuß |
| Freeman, John R., Jr.         | Reidenbach, F. W.            | Gibson, W. A.        |
| Fretz, Edward S.              | Rich, Wm. J.                 | Gramling, E. P.      |
| Gray, Arthur W.               | Richardson, Edw.             | Krom, L. J.          |
| Hamilton, Wm.                 | Ripper, J. E.                | McCulloch, Leon      |
| Hatts, T. A.                  | Roast, Harold J.             | Oesterle, J. F.      |
| Howe, H. E.                   | Roberts, R. T.               | Rand, Charles F.     |
| Hull, D. K.                   | Rollason, G. M.              | Rawdon, Henry S.     |
| Johnson, G. Alan              | Ross, Henry A.               | Skowronski, S.       |
| Jones, Jesse L.               | Salter, Jas. P.              | Waltenberg, R. G.    |
| Kaim, Henry J.                | Shaw, H. A.                  | Waterhouse, E. H.    |
| Karr, C. P.                   | Smith, F. G.                 | Waterhouse, H. C.    |

## REPORT OF THE NOMINATING COMMITTEE

The Committee on Nominations begs to submit the following as its nominees for the respective offices indicated, for the year beginning February, 1920.

*For President and Director:* HERBERT HOOVER.....Palo Alto, Calif.

*For Vice-President and Director:*

FREDERICK LAIST, Anaconda, Mont.....District 5

SEELEY W. MUDD, Los Angeles, Calif.....District 6

*For Directors:* W. R. WALKER, New York, N. Y.....District 0

A. S. DWIGHT, New York, N. Y.....District 0

R. M. CATLIN, Franklin Furnace, N. J.....District 1

G. H. CLEVINGER, Washington, D. C.....District 9

W. A. CARLYLE, Ottawa, Can.....District 11

POPE YEATMAN, *Chairman,*  
Committee on Nominations.

## WOMAN'S AUXILIARY OF THE A. I. M. E.

With the coming of the month of October the various sections are beginning active work for the winter.

The Colorado, Washington, Montana, and New York Sections are all doing good work in raising funds for the hospital bed at Rheims which is to be a memorial to the members of the A. I. M. E. who gave their lives in the great war. We hope that all the other sections will begin to work with this object in view and will make even a better record than they did with the Belgian Relief Fund.

It was with much regret that the President, Mrs. James F. Kemp, and the Secretary, Mrs. Sidney J. Jennings, were obliged to forego the pleasure of attending the Chicago meeting in September. They were, however, ably represented by Mrs. Arthur S. Dwight who gave an informal talk after which was formed the Illinois Section, which has our best wishes for all success—"Over the top and the best of luck!"

## COMMITTEE ON AMERICANISM

The Committee on Americanism held its first meeting of the Autumn on Sept. 18, and is now making effective the plans considered at the closing meetings of last spring.

The general scheme of the committee's activities is built around four distinct purposes: (1) Self-education in citizenship and Americanism; (2) the broadening of the committee's field of usefulness through a constantly increasing membership in the Auxiliary; (3) at least one concrete practical piece of work to further the cause of Americanism amongst the foreign born; (4) the bringing together of the members of the Auxiliary in lighter vein, through social meetings or meetings of entertainment.

To carry out these purposes a large committee has been formed for counsel, with four sub-committees for work. These committees are:

*Legislative*, Mrs. Florence Howe Hall, Chairman. This committee will follow local legislation affecting housing, education, and kindred matters bearing upon Americanism in New York City. It is planned to hold occasional meetings of the Auxiliary, with addresses by trained social workers and other meetings for open, informal discussion by members of the Auxiliary only.

*Membership*, Mrs. Arthur S. Dwight, Chairman. A systematic and personal campaign is now being carried on to reach every woman in the New York Section eligible to membership in the Auxiliary.

*Scholarship award*, Mrs. Jesse Scobey, Chairman. These vocational scholarships are to meet the needs of children from 14 to 16 years of age who are compelled to leave school, untrained for any trade, to engage in some gainful occupation because of the necessity of assisting in their own and their families' support. The Committee on Americanism has decided to raise funds to award a \$200 scholarship to a boy of foreign-born parents, in order that he may learn some trade allied to engineering. This means that \$4 weekly will be paid to a foreign-born family for one year, in order that a boy may be released from work to study his trade. This scholarship will be awarded through the Henry Street Settlement, which has awarded and administered these scholarships for

a number of years. The committee is now considering the merits of four candidates all equally recommended by the Settlement workers.

*Social*, Mrs. H. W. Hardinge, Chairman. The plans of this committee will be announced next month.

The committee is in receipt of the Bulletins from the Americanization Division of the Department of the Interior at Washington, D. C. and stands ready to coöperate with other organizations as the Department may at any time suggest.

Respectfully submitted,

(Signed) LOLA W. SCOBAY, *Chairman*.  
(MRS. JESSE SCOBAY)

#### MEMORIAL BED COMMITTEE

The Memorial Bed Committee, Mrs. Geo. D. Barron, Chairman, reports progress. A little more than half the sum necessary to endow a bed in perpetuity has been received. Intending contributors are asked to send their subscriptions to Mrs. Geo. D. Barron, Villa Aurora, Rye, N. Y.

#### REPORT FOR WOMAN'S AUXILIARY OF CHICAGO MEETING OF THE A.I.M.E.

The American Institute of Mining and Metallurgical Engineers gathered in Chicago on Sept. 21 for its 120th meeting. Its headquarters was the Congress Hotel and a comfortable room was assigned for the general meeting place of the ladies.

Mrs. MacDowell was chairman of the Ladies' Committee and she was most ably assisted by a group of Chicago women, dividing the days between them. A vote of thanks was extended to Mrs. MacDowell from the visiting ladies on the last day which but partly expressed the general appreciation of the delightful entertainments offered them.

One day was given to Chicago, its wonderful industries as expressed by Marshall Field's and Sears Roebuck's, and its most beautiful drives in both directions up and down the Lake. Another half day was spent at the Great Lakes Naval Training Station and a whole day on an excursion to La Salle where the large party of nearly four hundred ladies and gentlemen was most hospitably entertained.

On the last day of the meeting a charming luncheon was given to the ladies at the North Shore Country Club, a place of which any city would be justly proud. Mrs. Sidney Jennings was on the program to speak for the Woman's Auxiliary but in her unavoidable absence an opportunity was given me to say a few words. There were about forty ladies present of whom only a few were already members or had heard of the plan, so that I found it necessary to emphasize the primary ideas of the Woman's Auxiliary; namely, to be an organized body of women to give sympathy and support to the A. I. M. E. so that the wife, daughters, and sisters of every member might share in that organization.

After the talk there was a general discussion and questionnaire with the result that an Illinois Section was formed with the following ladies as temporary officers: Mrs. A. D. Terrall, 1043 Maple Ave., Evanston, Ill., chairman; Mrs. Carl Scholz, 547 W. Jackson Boulevard, vice-chairman; Mrs. G. M. Davidson, 211 N. East Ave., Oak Park, Ill., secretary.

On the train going to La Salle I interviewed a number of gentlemen on the subject of the Woman's Auxiliary. Many of them were younger men and practically all were strangers. Almost without exception they expressed themselves as being interested and very desirous that their wives should become members. I said that an invitation to join would be sent from the New York office with the information as to what was the nearest local section to each one.

The need for an appeal for membership in the Woman's Auxiliary was so foremost at this meeting and the time so limited that I could only bring in as a corollary the subject of the memorial beds in the American Memorial Hospital at Rheims. The booklets were distributed and as I had been at Rheims so recently it was a pleasure to say everything that I could as a means of interesting the ladies. I hope more may come of it later.

Respectfully submitted,  
(Signed) JANE R. DWIGHT.  
(MRS. ARTHUR S. DWIGHT.)

#### WASHINGTON SECTION

Mrs. Frederic Keffer, Director, reports that the Section voted unanimously to send a contribution to the endowment of the Memorial Bed and hoped to send more later on, being very enthusiastic over the idea.

#### MONTANA SECTION

Excellent meetings have been held at Butte, Anaconda, and Silver Bow. The presence there of Mrs. James F. Kemp, our President, has been most stimulating and Mrs. Chas. D. Demond, Director of the Section, expects to begin active work again now that the summer vacations are over.

#### COLORADO SECTION

Director, Mrs. Thos. B. Stearns. This Section is working for the Memorial Bed and has already sent one contribution.]

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### MEETING OF CANADIAN MINING INSTITUTE

A regular general meeting of the Canadian Mining Institute will be held in Vancouver, B. C., on Nov. 26-28. The Council extends a cordial invitation to all members of the American Institute of Mining and Metallurgical Engineers to attend.

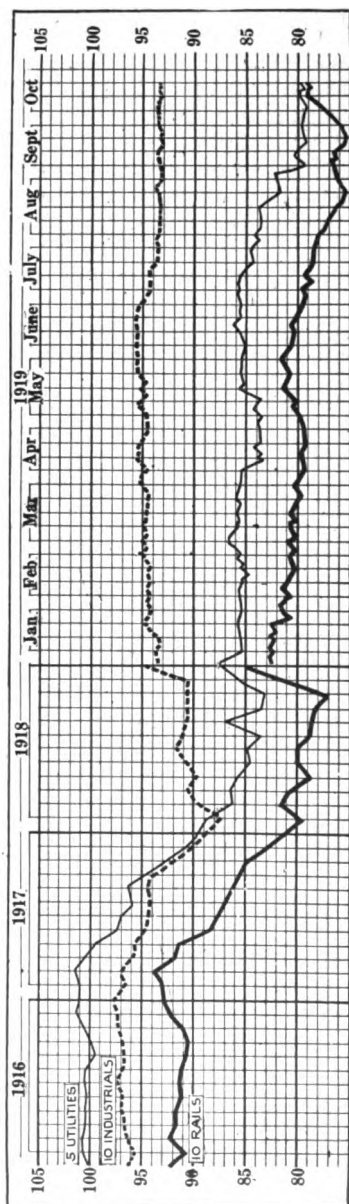
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### THE ENGINEERING FOUNDATION

A Progress Report of The Engineering Foundation, which is a history of the Foundation and a report of its activities, has been printed. A limited number may be obtained by members of the Institute by writing to the office of the Institute or to the Secretary of the Foundation.

## TREND OF BOND AND STOCK MARKETS

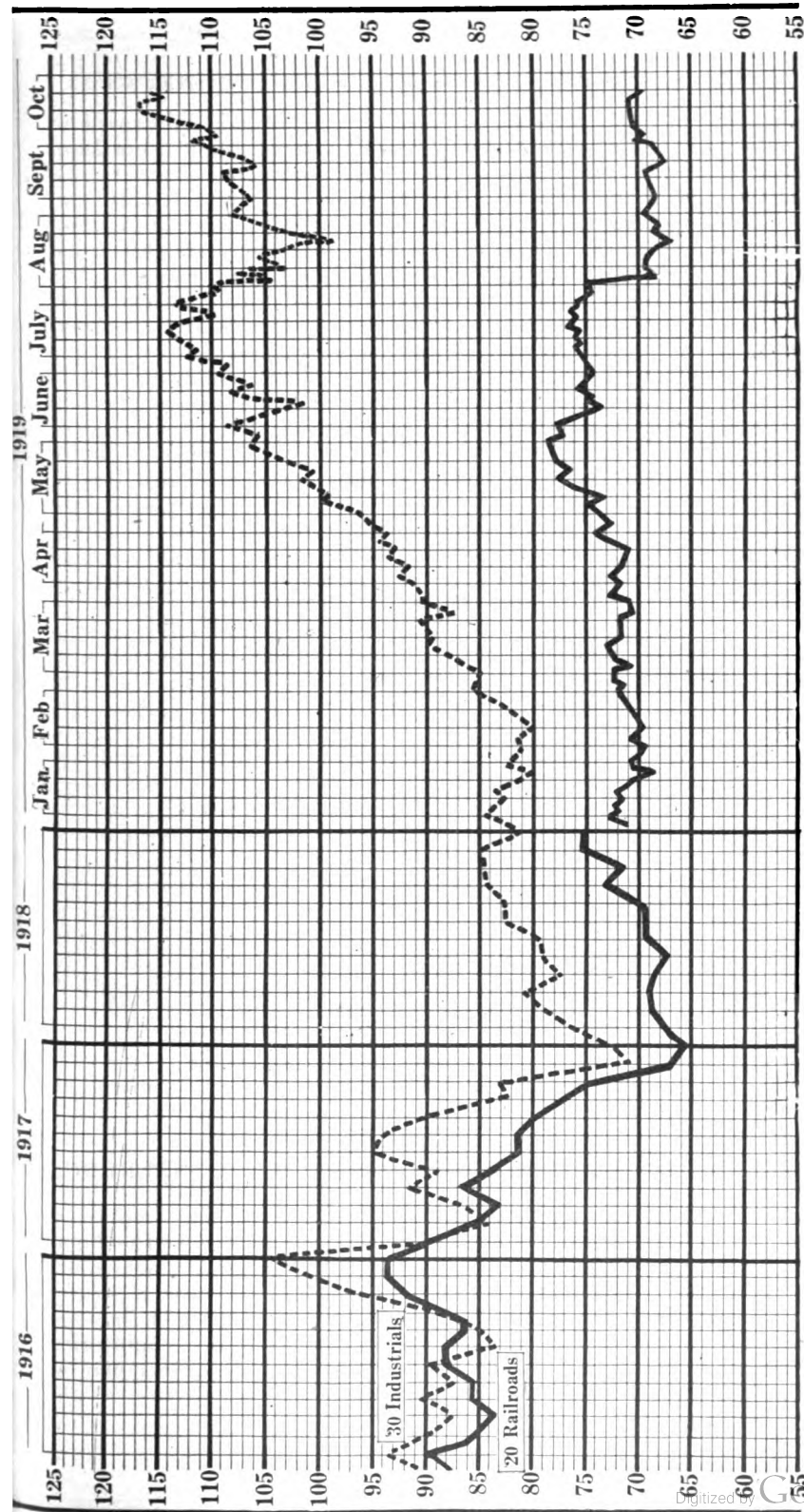
For the benefit of those of our members who are considerable holders of securities, but owing to their isolated situations are not in close touch with the metropolitan market and current quotations, we are publishing



PRICE TREND OF NEW YORK BOND MARKET

This graph shows the average prices of ten railroad, ten industrial and five public utility bonds on the first business day of each month from January, 1916, to December, 1918, and the weekly fluctuations since January 1, 1919.

two very interesting graphs, showing the course of the bond and stock markets in New York over a long period. These graphs are furnished through the courtesy of the financial department of the New York Tribune.



PRICE TREND ON NEW YORK STOCK MARKET

This graph shows the average prices of twenty railroad stocks in one line and thirty industrial stocks in the other on the first business day of each month from January, 1916, to December, 1918, and the weekly fluctuations since January 1, 1919.

## COLORADO CONDEMNS LAW LICENSING ENGINEERS

Under date of Sept. 30, the following open letter was addressed to the Members of the Colorado Section of the American Institute of Mining and Metallurgical Engineers by a Colorado Committee:

At a meeting of the Colorado Section of the American Institute of Mining and Metallurgical Engineers, held on Friday, Sept. 19, a resolution was unanimously passed condemning the Engineers' Licensing Bill passed at the last session of the State Legislature, and requesting the Chairman to appoint a Committee to act in conjunction with the other National Engineering Societies and the Colorado Metal Mining Association, with a view to securing its repeal at the extra session of the Legislature which the Governor has expressed his intention of calling.

It may be within your knowledge that the bill in question was passed by the Legislature and signed by the Governor without the knowledge of any of the National Societies, and of few if any of their members. Under its provisions residents of other states cannot even come into this to examine a mine without securing a license, and aliens (among whom are many honored members of the profession in Colorado) cannot obtain such a license at all. The mining industry in this state needs the coöperation of outside engineers, and we should welcome any assistance from them that will tend to develop our resources. To attempt to discourage the activity of visiting engineers will inevitably react on us, and brand the state as being hostile to brains and capital from outside. The difficulty of securing a license will prove a serious handicap to young engineers starting out in the independent practice of their profession. Moreover, a license issued to an engineer qualified in one branch will entitle him to practice in any other: so that the license is apt to mislead the public.

All members of the Institute are requested to immediately communicate with State Senators and Representatives, and to request them to write to the Governor expressing their readiness to coöperate in the repeal of this obnoxious measure.

The Governor of the State has expressed a willingness to include the repeal of this bill as one of the objects of the special session of the Legislature which he is about to call together, if a general sentiment is shown to exist sufficient to assure him that its repeal is generally desired.

Yours respectfully,

GEORGE E. COLLINS,  
ROBERT HURSH,  
J. C. ROBERTS,

*Committee.*

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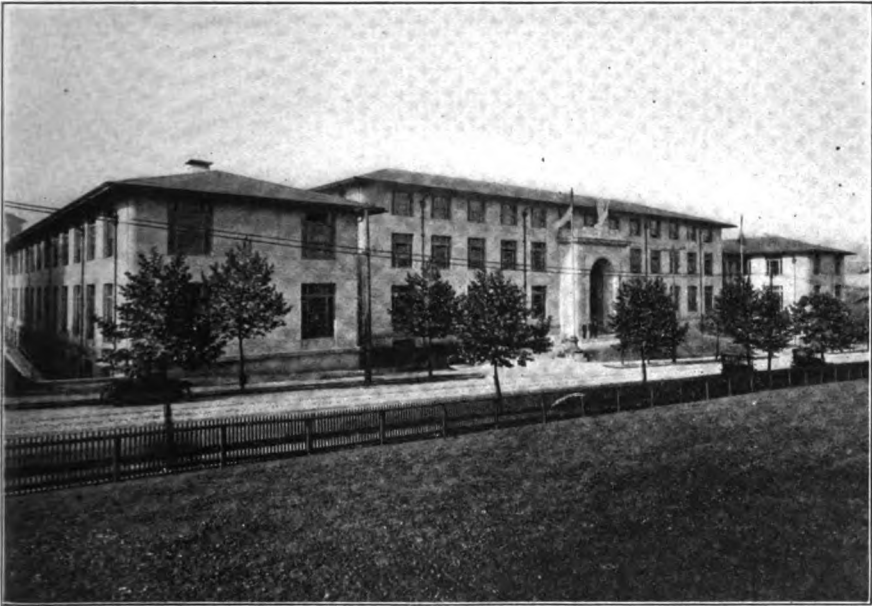
## ENGINEERS IN PAN-AMERICAN FINANCIAL CONFERENCE

Those in charge of the Second Pan-American Financial Conference say that the engineering profession will be well represented at the January conference in Washington. Latin American engineers are more closely connected with important industrial projects and have a greater command in matters pertaining to the developments on which they are working than is the case in the United States. Our own engineering profession may therefore do well to study the Latin-American plan of coöperation between capital and the engineers.

## DEDICATION OF BUREAU OF MINES EXPERIMENT STATION

Many of those who attended the meeting at Chicago spent the first part of the following week in Pittsburgh, when the Experiment Station of the Bureau of Mines was dedicated and the fourth annual First Aid and Mine Rescue Contests were held. The Bureau buildings were open for inspection during the three days, Monday, Tuesday, and Wednesday. The dedicatory ceremonies were held in the Bureau of Mines main building, Monday morning, Sept. 29, Mr. T. J. Gillespie, representing the Pittsburgh Chamber of Commerce, presiding. In his address of welcome, Hon. E. V. Babcock, Mayor of Pittsburgh, said:

"The reclamation work already done stands out conspicuously beneficial to industry and populace alike all over the United States.



PITTSBURGH EXPERIMENT STATION, BUREAU OF MINES. FRONT VIEW.

It has demonstrated methods of preservation of life and reclaiming of injured persons which are new and greatly beneficial to modern civilization. The establishment of this institution in Pittsburgh was greatly desired, and now it is here it is greatly appreciated."

The response was given by First-Assistant Secretary of the Interior Vogelsang, who represented Secretary Franklin K. Lane. He said that the Bureau of Mines did more during the war for the triumph of American arms than any other institution.

After the key of the building was presented to Director Van H. Manning by Secretary Vogelsang, an address was given by J. Parke Channing, who represented President Winchell. Addresses were also given by John L. Lewis, acting president of the United Mine Workers of America, and Hon. William C. Sproul, Governor of Pennsylvania.

Governor Sproul said that although they may be considered radical, he would make to the next legislature recommendations that will be effective in bettering housing conditions of miners and other workmen, saying: "I am very much interested in this question of housing. You can have safety devices and more comfortable working conditions in the mines, but you cannot raise good citizens in squalid unsanitary homes. It is the duty of the state to help. Mining is not a parlor occupation, and it is necessary that we do everything within our power to conserve the health and strength of the miners."

Tuesday and Wednesday were given over to the contest of the First Aid and Mine Rescue teams. Twenty-four teams from eight states



PITTSBURGH EXPERIMENT STATION, BUREAU OF MINES. REAR VIEW.

were entered in the elimination mine rescue contest, and eighty-eight teams from sixteen states were entered in the elimination first-aid contest. In the final tests which took place on Wednesday, ten teams were in the mine rescue contest, and twenty teams in the first aid contest.

The Pittsburgh Station is the home of the Coal Mining, Mine Safety, Fuel, Electrical, Mechanical, Chemical Sections, National-Gas Research Unit, Byproduct Coking Research Unit, Microscopic Research Unit, Petroleum Laboratory, Explosives Chemical Laboratory, Metallurgical and Metallographic Laboratories, Physical Laboratory, and the Administrative Section.

## THE ENGINEER IN INDUSTRY

Engineers who are in charge of industrial operations, and their number is legion, sense as much as anyone the present feeling of unrest in the country and more than anyone else realize the present inefficiency of labor. Undoubtedly the two phenomena are closely correlated and no doubt are due to a multitude of causes which it will be impossible to enumerate. From my experience in mining I estimate that the present efficiency of labor is only about two-thirds of what it was under pre-war conditions.

In the mining industry, at least, we have not a large surplus of men looking for work and usually under these conditions men are rather more independent and will not work as efficiently and faithfully as if they felt there were plenty of men ready to take their places. Wages in metal mining have advanced more than the increased cost of normal and sane living. The result is that the men often work fewer days in a month and do not seem to have very much interest in their work while actually engaged in it. Then again, they have been listening to the more or less vague propaganda of the I. W. W. and the radical wing of the socialists, who are harping on the fact that the distribution of newly created wealth is unfair and that the laborer really is not working for himself or his fellow laborers but is carrying on his exertions for the benefit of a small and limited class of exploiters. A continued harping on this view is bound to influence the judgment of even a conservative workman who is not a student of economics and who hears little or nothing upon the other side. I am a great believer in the common sense of the American people and in the long run I do not think that they will be carried away by unsafe doctrines.

The trouble with so many of these propagandists of industrial inequality is that they do not differentiate between production and distribution. Even if we admit that distribution is unfair, unless goods are produced there will be nothing to distribute. A great many unthinking people seem to feel that wages are paid out of a pot which is inexhaustible and do not realize that eventually what comes out of the pot can never exceed what is put into it. The workman is not paid in money but is paid in goods, money as we all know being used simply as a measure of value and a medium of exchange, and that all that can be used to pay the laborer is what he produces.

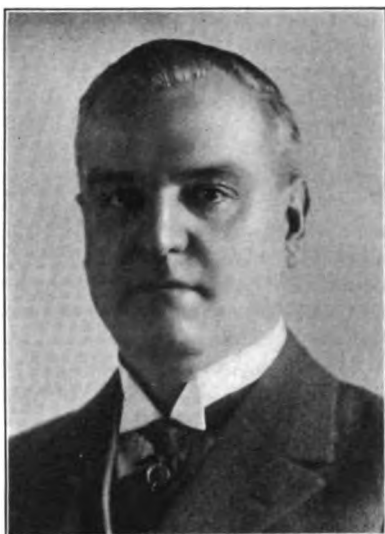
We hear talk of over-production. As long as there are men with ragged shoes in the United States can it be possible to produce too many shoes? The answer is obvious. If the average worker at Lynn turns out one pair of shoes per day when he could make two, it follows that the mass of the workmen, who are the large users of shoes, will have to pay just twice as much as they should. The same thing applies to coal, to iron, to steel, and to all of the necessities of life.

When it comes to distribution there undoubtedly in the past have been injustices and there probably are injustices today but there are sane and logical methods of correcting these abuses or inequalities for which all of us should strive.

The annual production of new wealth in the United States is probably

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\* An address delivered by J. Parke Channing at the dedication of the Pittsburgh Experiment Station. U. S. Bureau of Mines, Sept. 29.



VAN. H. MANNING, DIRECTOR,  
BUREAU OF MINES.



E. A. HOLBROOK, SUPERINTENDENT OF  
PITTSBURGH EXPERIMENT STATION.



DORSEY A. LYON, SUPERVISOR OF  
PITTSBURGH EXPERIMENT STATION.



J. PARKE CHANNING, A. I. M. E.  
SPEAKER AT DEDICATION.

in the neighborhood of \$50,000,000,000 a year, at least that is the figure which is advanced by some economists for the year 1916. As near as may be determined between \$35,000,000,000 and \$40,000,000,000 of this goes to the laborers, or workmen, as distinguished from those who work with their brains or who are capitalists. This would give a maximum of about \$1000 a year to each one of these workers. If the whole \$50,000,000,000 was distributed to them they could not expect to get over \$1250 a year. It is, of course, manifest that the laborer cannot expect or demand all of this production because as we all know industry will not go on unless it has brains to direct it and brains must be paid and must be paid better than the man whom he directs.

I am inclined to think that a great deal of the unrest among the laborers is due to the fact that possibly this \$40,000,000,000 may be inequitably distributed among the different classes of workmen themselves.

I have been informed by Mr. W. R. Ingalls, a distinguished member of the American Institute of Mining and Metallurgical Engineers, which organization I represent at this Dedication, that he has been at work for a year on an attempt to distribute the income for the United States for 1916. The result of his investigation will soon be published, and in the meantime, I have his permission to quote from some of his deductions as to the distribution in the form of wages.

He estimates that for that year 7,000,000 farm laborers received \$400 per annum; 7,000,000 farm proprietors received \$743 per annum, as a money wage, in addition to which they and their families consumed parts of the products of their farms, whose value probably never entered into any statistics. 7,200,000 factory workers received on an average of \$675 per annum; 1,700,000 steam-railway workers received on an average of \$886 per annum; and 150,000 metal-mine workers received on an average of \$1250 per annum. If we should still further segregate the steam-railway workers, we would find that certain classes of them were very much higher paid than the average and, correspondingly, the other classes were much lower paid. I am not prepared to say that this distribution is unfair but it simply shows that there are these differences and that it is just as important to consider if they are unfair as it is to consider the possible inequality of the amount given to management and capital.

I, myself, take issue with those socialists who claim that the wage system is a system of robbery. I believe that the wage system is the only system under which production has been successfully carried out and can be successfully carried out, unless perhaps the time might come when human nature was so changed that everybody was equal, both in natural ability and education. It is absolutely false to declare that our present wage system has been the growth of the old feudal system, or that our present capitalists are the descendants of the feudal barons of the Middle Ages. Every civilized country that has become industrial has, by evolution, automatically adopted the wage system.

The United States started as a simple community in which almost every family produced all of the necessities of life. It was not influenced by any social system that existed in Europe or in England and yet in the last 100 years it has automatically and perforce developed an industrialism based on the wage system. So I take this opportunity of saying that I believe the wage system is one that can be justified to the bitter end.

Capital is created only by saving, and saving means putting aside for other uses part of the production of industry so that when a new plant or a new factory has to be built there is food, clothing, furniture, and houses to take care of the men who are building the new plant and getting it into shape before it is capable, in turn, of producing new wealth. Unless out of this \$50,000,000,000 worth of annual production some of this is set aside for new construction and renewals it is easy to see where the country would be in a few years.

I believe that a larger proportion of the savings of the country are from those of the so-called capitalistic and management class than from the laborers, though the conservative laborer is always saving and striving to increase his wealth. It is a fallacy to say that there is a marked division between the classes of employers and workmen, that the world is divided into exploiters and slaves. There is a constant flux and the rich man of today is perhaps working with his hands in a few years while on the contrary the laborer of today may be, in a few years, in the capitalistic class simply on account of his own savings and exertions and be an employer of labor. There is no such thing as a class struggle.

It undoubtedly is a fact that a great many of the newly rich are improperly using their incomes. Instead of living in a sane manner and keeping a large portion of their income for new capital investments they are spending every cent they get in extravagances and are encouraging the production of non-essentials. In the same way, I regret to say, the vast majority of workmen are living up to the handle and in case of illness or death of the breadwinner have not a cent on hand to tide them over. I think that the rich man who indulges in this extravagance is to be more severely censured than the laborer.

I heard only the other day of a titled Englishman who said that before the war he kept on his estate sixty gardeners who were principally engaged in keeping the lawns, flower beds, and hedges in shape, that since the war a large portion of his estate has been turned into agricultural lands, that he had reduced his gardeners to six and that the other fifty-four were engaged in the production of food. He, himself, stated that he was glad this had occurred and that never again would he return to the old regime.

I believe one thing which has led our unthinking men to harp upon the unequal distribution of wealth is their failure to realize the difference between fixed capital and income. When the proletariat seized the property of the bourgeoisie in Russia, they soon found that rugs and furniture and houses would not feed them; and that when the peasants declined to plant more than was necessary for their own use because they were unwilling to sell the balance for worthless paper roubles, the proletariat in the cities starved by the thousands. We must keep steadily before us that it is the annual flow of production upon which we subsist.

Undoubtedly in the past the employers as a class have been too autocratic and have not taken the workmen into their counsels or treated them as if they were men. There is a feeling that there must be better coöperation between the employer and the workman and I believe that this spirit of coöperation can always be better carried out by managers with an engineering training. Engineering is so intimately connected with all of our production that it cannot go on without it. The engineer, from his very training and experience and his continued contact with

the various problems of production, has been made to look at things from an objective and not a subjective point of view. The parlor Bolshevik knows little of the stern realities of industrial life and his theories and suggestions are of but limited value. The engineer, and particularly the engineer manager, is the main contact between the employer and the workman and the basis of this contact must be The Golden Rule, or as it has been otherwise stated, the principles of Justice. If you give a man a "square deal" he has no "kick coming."

In order that this proper appreciation of the human element in industry may be emphasized I am glad to say that most of the engineering schools today have a course in "Human Engineering" as they realize that it is of just as much importance for a man to understand the human machine as it is to understand the inanimate machine. The older man has got this by experience and the younger man is having it instilled in him in his preliminary technical training.

We hear a good deal today of industrial democracy and I believe a definition of industrial democracy is just as difficult to give as that of political democracy. At a recent convention of 250 manufacturers held at Silver Bay, under the auspices of the Y.M.C.A., the consensus of opinion was that the expression "democracy in industry" was a better term. I am informed that some of the radicals think that democracy in industry means that the workmen should select their foremen and superintendents up to the grade of the general manager and that he alone should be the one appointed by the company. I consider this absolutely impracticable. If industry is to be carried on efficiently the manager, the superintendents, and the foremen must be selected by the company. It is here that the greatest care must be taken. The management may have most excellent ideas in regard to its relations with the men, but if the superintendents and the foremen are not well instructed and in sympathy with this the whole desire of the management may go for naught. It is today being more and more realized that foremen should be selected for their knowledge of human nature and their capacity to get on with men rather than for their technical skill in their particular departments.

To my mind democracy in industry means coöperation with the workmen, in discussing with them the question of wages, hours of work, and working conditions. The question of working conditions is the most important and on it will depend the health and comfort of the worker and the efficiency of the plant. Many and many a good suggestion comes from a workman and it is foolish to repress him and not to give him an opportunity to make suggestions which if adopted will give him, and perhaps even his associates, the greatest joy of their lives.

I had the opportunity the other day of hearing Mr. H. Mensforth, of Manchester, England, who is the manager of a large industrial plant and who also is the President of the Manchester District Engineering Trades Employers Association, make an address and the next day I met him and got from him a most excellent and illuminating description of the growth and coöperation between the employers and the workmen in England, this coöperation being effected primarily by what are known as "Works Committees." Much to my surprise he told me that this growth was all inside of the last 3 years; that 3 years ago there probably were not over a dozen "Works Committees" in England, and that today

he doubted if there were more than that number of shops which did not have these "Works Committees."

These "Works Committees" would, for example, consist of twelve men selected from the workmen and two men selected from the staff representing the company. This committee would meet once a week on company time and matters would be brought up before it which were suggested either by the workmen or by the management, and he said it was surprising to learn the number of satisfactory decisions they made and the way in which they eliminated so many previous sources of friction. He said he thought we in America should profit by their experience and have sufficient vision to realize the advantage of this coöperation.

He admitted that undoubtedly it would be easier to adjust industrial relations in England because of the fact that practically all of the men spoke English and down in the bottoms of their hearts were Britons through and through, believed in the constitution of their country, and had an abiding respect for law and order. He realized that our problem in the United States, with our vast unassimilated mass of foreigners, was a harder one. And right here let me say that I think one of the important things we should do is to carry out our problem of Americanization, and the first thing in Americanization is that a man should learn the English language.

Mr. Mensforth further told me that the management in hundreds of factories realized the importance of education, and particularly of education for the younger men, and that in their works they had established schools in which the younger men were instructed on company time, feeling that this instruction of the men eventually redounded to the company's advantage. Their general scheme was first to try to inculcate in these young men the ideas of good citizenship and then to give them technical instruction in the business. Outside teachers were never used, the teachers always being drawn from their foremen and engineers, and from among the better class of workmen. The results were three-fold; the young men were taught, the foremen were taught, and a bond of sympathy was created between them.

The engineer, then, in his relations with the workmen must realize that first and foremost there must be justice. He must realize that the health of the men must be conserved. No sick man can ever have a sane view of life. He must strive as much as possible to make the workman have an interest in his work, explaining to him the operations which are apparently inexplicable and the bearing they have upon the industry or the work of the plant as a whole. He must encourage the men toward right living and economy, as one of the greatest desires and satisfactions of life is to own something. He must see that as far as possible his plant is made attractive because a man feels better and works better in a well-lighted, well-ventilated, and well-kept plant than in a dirty, grimy place. And lastly, he must not repress the desires of the workmen to associate but should encourage his men to get together and to form associations just the same as he, himself, belongs to his various engineering organizations. But at the head of it all, and as his guiding star, he must remember that justice is at the basis of all industrial as well as social relations.

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Under the Canadian Referendum Act of 1919, all Indians who were on active service are entitled to franchise.

## MEXICO IN THE METROPOLITAN NEWS

This brief résumé of the events transpiring in Mexico, culled from the daily New York newspapers since the last *Bulletin* went to press, does not show any degree of improvement in the situation.

## MEXICO SEEKS TO AVOID BLAME FOR BANDIT RAIDS

All foreign passengers leaving Nogales for Mexico on the Southern Pacific or Mexico Railroad, whose business would take them through territory occupied by the Yaqui Indians or Mexican bandits were requested by Mexican Consul Emilio Tamez to sign a statement that they relieve the Mexican government of responsibility for anything which might happen to them while in that part of Mexico. The Mexican consul stated, says the N. Y. *Tribune*, that this was by order of Mexican Ambassador Ignacio Bonillas, at Washington.

When the State Department was advised of this activity Secretary Phillips, in a message to the consulate at Tampico, according to the N. Y. *Tribune*, asserted that "compliance with the waiver requirement will not interfere with the relation existing between the United States and its citizens and that Americans so complying will in no way lose the protection of this government."

## CARRANZA PLEADS FOR OUR FRIENDSHIP

In the course of an inspection trip which President Carranza was making, the President observed to a N. Y. *Times* correspondent, according to its special cable, that it was very curious that the American press continued to attack Mexico, and in particular himself, accusing him of always trying to provoke difficulties, when in reality the only thing that Mexico wanted was friendly relations, with respect for her rights.

"Do the American people realize that war would mean waste and the loss of thousands of lives for no real reason? If the agitation for intervention is based upon the killing of some unfortunate Americans in certain regions—which we sincerely regret, the regions not being fully under control—would it not be better for others to desist from entering these regions until full protection can be assured? The fact that Mexico, although sadly needing funds, is willing to pay indemnities for these unfortunates should be proof that she is trying to protect foreigners, not to injure them.

"You can see that it would cost many lives to dominate this region alone. If some who want war could come here and meet us, see the real conditions, see that the people are interested only in rebuilding the country and recovering losses, and that we only want peace and an opportunity to repair the damages caused by many years of revolution, they would return to the United States convinced of our good faith."

## MEXICO IN SCHOOL TANGLE

Mexico City's public schools are all closed because of the failure of the Government to pay the teachers, according to articles in *El Universal* and *Excelsior*, two of the Mexican newspapers, says the N. Y. *Times*. It is said that the teachers have received no pay since May, and that more than 100,000 in the Federal district alone are without school facilities. The newspaper articles contradict statements recently made by the Mexican Ambassador, Mr. Bonillas, at Washington, who said that the schools are in a better state than ever before. Persons interested in the schools assert that the Carranza Government has taken away from the municipalities 50 per cent. of the taxes belonging to them for public service. It is also charged that the Government has appropriated to its own use property worth \$200,000,000, the income of which went to the schools under bequests made by wealthy individuals.

## MEXICANS GET \$6,000 TO FREE CAPTIVES

Six thousand dollars in gold was paid Mexicans on Sept. 13, for the release of Dr. J. W. Smith, an American, and E. Monson, or Munson, believed to be a subject of Sweden, who were taken from a train near Santa Eulalia, Chihuahua, yesterday morning, according to telegrams received from Chihuahua City, says the N. Y. *Times*.

Paul Steger, a Swiss citizen, Superintendent of the Minerals and Metals Company properties near Santa Eulalia, and William Dwelly, a British subject, were also cap-

tured from the train, but were released after the payroll of the Buena Tierra Mine, of which Dwelly was foreman, had been seized by the bandits.

#### ALL RECORDS ON MEXICO CALLED FOR BY SENATE

Virtually the entire file of correspondence between the Mexican and American Governments, it is expected, will become a part of the records of the Senate Foreign Relations sub-committee investigating the Mexican situation, says the *N. Y. Tribune*. Chairman Fall of the sub-committee said that he knew of no reason why the Department would withhold any information at its disposal, but that a part of it, especially that relating to certain claims, might be read in executive session.

#### DEFENDS PAYMENT TO MEXICO REBELS

In reply to charges made by Luis Cabrera, Carranza's Minister of Finance, that oil concerns in the Tampico region were voluntarily aiding rebel forces in Mexico by paying tribute and supplying arms, a memorandum was put in evidence before the Senate committee investigating Mexican affairs to show that tribute, in the form of forced loans, had been taken by Carranza forces during the revolution in Mexico; that payment was made with the consent of the American officials, and that such payment was essential to prevent heavy losses. It was denied that arms were furnished to the rebels.

#### SAYS CARRANZA PAID FOR WEEKS' PAPER

*La Revista Mexicana* (the Mexican Review), the paper of which George F. Weeks, the Mexico City correspondent of the League of Free Nations Association, is the editor, says the *N. Y. Times*, was founded in Washington, D. C., in 1916 by the Department of Foreign Relations of the Mexican Government, the editors at that time being Weeks and George L. Edmunds. The latter a year ago severed all connection with the publication.

The fact that the paper had been financed by the Mexican Government for propaganda purposes in the United States was disclosed to the sub-committee of the Senate Committee on Foreign Relations by Mr. Edmunds. He said that when published in Washington *La Revista Mexicana* had a circulation of from 13,000 to 15,000 copies a month, but that only a few hundred copies were paid for by subscribers, the Mexican Government paying the difference. It was *La Revista Mexicana* that first printed the false charge that the *New York Times* had published a spurious map relating to rebel activities in Mexico. The story was sent to the League of Free Nations Association in New York and by that association given to the *New York Call*, which republished it.

#### FORTHCOMING MEETINGS OF SOCIETIES

| Organisation   | Place             | Date       |
|--|-------------------|------------|
| 1919   |                   |            |
| National Drainage Congress.....                            | St. Louis, Mo.    | Nov. 11-13 |
| American Mining Congress.....                              | St. Louis, Mo.    | Nov. 17-21 |
| Canadian Mining Institute.....                             | Vancouver, B. C.  | Nov. 26-28 |
| American Society of Mechanical Engineers.....              | New York, N. Y.   | Dec. 2-5   |
| American Institute of Chemical Engineers.....              | Savannah, Ga.     | Dec. 3-6   |
| Geological Society of America.....                         | Boston, Mass.     | Dec. 29-31 |
| 1920   |                   |            |
| American Society of Heating and Ventilating Engineers..... | New York, N. Y.   | Jan.       |
| Mining and Metallurgical Society of America...             | New York, N. Y.   | Jan. 13.   |
| American Institute of Min. and Met. Engineers..            | New York, N. Y.   | Feb. 16-19 |
| American Ceramic Society.....                              | Philadelphia, Pa. | Feb. 23-26 |

## ENGINEERS AVAILABLE

(Under this heading will be published notes sent to the Secretary of the Institute by members or other persons introduced by members.)

**Mining Engineer.** Graduate of Colorado School of Mines, 1912, experienced in coal, lead manganese and limestone mining, wishes executive position. A-2146.

**Graduate Mining Engineer.**—Discharged, reserve officer, age 32, single, 7 years' experience holding responsible executive positions, in iron, copper, and talc mining. Well recommended. A-4913.

**Mine Manager, Superintendent or Engineer.** Age 41, graduate of Michigan College of Mines; 20 years' experience in responsible positions in connection with large operations; in iron, copper, pyrites, lead and zinc mines; successful in finding and developing orebodies, increasing production, and reducing costs. Desires a position with a future. A-4081.

**Mining Engineer.**—Graduate from Polytechnicum, Stockholm; 14 years' practical experience in Sweden, United States, Belgium, and Spain, in iron-ore development, mining, and milling; thorough knowledge of English, French and Spanish; desires position as superintendent or assistant manager. Good references; member; now in Sweden. A-4914.

**Research Engineer.** Now in Chile on the erection of a 50-ton mill with modern machinery for the treatment of Chilean nitrate. Desires connection from the first of next year; with firm operating in South or Central America. A-4915.

**Metallurgical Engineer.** Junior member, age 26, single, graduate Columbia School of Mines; recently discharged as lieutenant in the heavy artillery. A-4916.

**General Superintendent.** Technical graduate, age 35, desires position over a group of four or five mines or as assistant general superintendent for a large company. Has had experience in superintending mines, construction work, opening new and abandoned mines, safety and efficiency engineering and handling organized labor. At present employed by a coal company in the middle West. A-4917.

**Mining Engineer.** University graduate, 10 years' practical experience in gold and silver mining in Canada, Transvaal, and Rhodesia, desires position of responsibility with mining or other concern. Sand filling a specialty. A-4820.

**Copper Smelter, Non-ferrous Metallurgist.** Ten years' experience in copper smelting and refining, covering design, construction, operation, and metallurgical investigation on blast furnaces, reverberatories and converters. Prefers operation or non-ferrous industrial metal investigations. At present engaged in brass foundry. Minimum salary \$3300. A-1541.

**Engineer, Executive or Assistant.** Technical graduate, 8 years' experience; 4 years, structural and 4 years, mining. Last 4 years engineer in executive office of coal company operating fifteen mines. Thoroughly familiar with managerial and technical details of mining, development, surface plant and general operation, also with production, cost and labor figures. A-3680.

**Metallurgical Engineer.** Executive operating, and research experience, in gold and silver milling and grinding plants, covering 8 years; four of which superintendent, in the United States, Canada, and Spanish

America. Age 31, married. Technical graduate. Speaks Spanish, French, and German. Location immaterial. A-1029.

**Engineer, Specialty Ore Dressing.** Gold, silver, copper, lead, zinc manganese, magnetic and non-magnetic iron ores, coal washing, amalgamation, flotation, water conservation, testing, designing, construction, operation; mining, and mining methods; 20 years' exceptional experience in United States, Mexico, Europe, Asia. Available on short notice. A-2682.

**Engineer;** administrative type; technical, legal and accountancy education; 11 years' practical experience, chiefly about mining, power, metallurgical and chemical plants (both construction and operation), desires change. Qualified for position of works engineer, construction supt., etc., or else as manager of small plant. Salary desired, \$3600 in U. S. to start. Foreign connection also considered. A-294.

**Manager-engineer.**—General and diversified engineering and management; valuable experience; mining and milling; mining practice east, west and Mexico; civil, mechanical, electrical; public utilities, mines, industrials; steam and hydroelectric power; examinations, reports; design, construction, operation; rehabilitation of plants during operation; particularly refer to preservation of financial balance. Age 43, married. A-4972.

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### COLLEGE REGISTRATION FEES REMITTED TO STUDENTS ATTENDING A. I. M. E. MEETING

The University of Illinois, by Prof. H. H. Stoek, professor of mining engineering, sent out to its mining students a long letter urging them to attend a Chicago meeting of the Institute. It stated that the University Council authorized the remission of the registration fee for sophomore, junior and senior mining engineers who would attend the meetings and present a written account of the sessions and excursions attended.

Young engineers are rarely flushed at the beginning of their careers but if they ever expect to amount to anything at the end of 10 years they are going to regret that they have not long been a member of the Institute. So that the slogan "Do it now" is more than particularly applicable in their cases and nothing will better indicate to them the scope of the Institute's work and the advantages which they are to get from membership than attendance at one of the big meetings of the Institute and the preparation of a written report on the sessions and excursions attended to be returned to the University.

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### TECHNICAL MEN FOR THE CONSULAR SERVICE

Officials of the State Department have expressed their hope that a considerable number of technical men will take the examination for consular service. The Department recognizes that the interest of the United States will be served best if technical men are made available through these examinations for vacancies at points where their training will be of special value. Industrial engineers who have passed the consular examination will be assigned to industrial centers of Europe or South America. Mining engineers, chemists, electrical engineers, etc., will be assigned to industrial centers requiring special training.

## POSITIONS VACANT

**Geologist or Mining Engineer** who has had sufficient experience to make examination of a large area and who can report upon economic value of any minerals found. Work will extend over a period of 2 or more years. Location, India. R-1660.

**Assistant Superintendent** of malleable and gray iron foundry, young man. Must have thorough molding experience, especially on squeezers, knowledge of mixture control and operation of air furnaces, cupolas, and annealing ovens. College graduate preferred. R-1727.

**Engineer** thoroughly familiar with distilling, evaporating and drying machinery. Capable of taking charge of entire evaporator department, including engineering and selling. New Jersey. R-1550.

**Experimental Draftsman** familiar with small automatic mechanisms, principally those produced in large quantities by punch-press methods, such as adding machines or typewriters. New York City. R-1566.

**Patent Draftsman**.—At least 2 years' experience on perspective rendering of small automatic machinery. New York City. R-1570.

**Designer**.—Familiar with hydraulic work and capable of going ahead with detail and design work without supervision. Pennsylvania. R-1575.

**Superintendent or Foreman**. Knowledge of ceramics, clay products, electric porcelain, tile, factory materials, etc. New York State. Good salary to right man. R-1578.

**Designer**. Experienced in designing mining machinery, including electric hoists. Canada (Quebec). R-1589.

**Construction and Operating Superintendent**. Executive and thoroughly experienced in the zinc melting industry. Will have charge of construction of plant and its operation. Salary \$6000 to start; increase to \$8000 later. India. R-1593.

**Construction and Operating Foreman**. Executive thoroughly experienced in chamber sulfuric-acid plant work. Will be in charge of the construction of plant and its operation. Salary \$4000 at start; increase to \$5000 later. India. R-1594.

**Mining Engineer**. Young man, graduate of first-class school of mines, with some practical experience, knowledge of Spanish would help, for surface and underground surveying and topographical and mechanical drafting principally; to be trained in our methods. Mexico. Salary \$150 U. S. Cy. per month. R-1607.

**Assistant Manager of SO<sub>2</sub> Plant**. Able to take charge of operations of sulfur-dioxide plant while manager is away and so develop that in time he would be able to take entire charge of the plant, leaving manager free to occupy himself with other work. Technical education not entirely necessary. Norfolk, Va. Salary \$150 (approximately) per month. R-1628.

**Draftsman**. Thoroughly experienced in all round work, having knowledge of machinery, structural steel, concrete, etc. for the position in copper smelting work. Arizona. R-1629.

**Mechanical and Structural Draftsman**. Extensive experience in mill design. Utah. Salary \$200 to \$225 per month. R-1632.

**Sales Engineer**. Highest type engineer with sales ability; desirable that man have had shop experience and be between the ages of 35 and 45 years. Proposition is to sell scales. Restricted territory in vicinity of New York City. R-1634.

**Engineer for Gas-producer and Combustion Work.** Technical training and some practical experience. Should be capable of conducting tests on gas-producer plants to determine gas quality, efficiency, etc. Should be 25 to 30 years of age and must have initiative and promise of development. Delaware. Salary \$200 to \$250 per month. R-1636.

**Graduate Chemical Engineer.** Young man with chemical experience and executive ability. New York. Salary \$35 per week to start. R-1677.

**Chemist.** Familiar with the working of alum for commercial purposes and capable of managing an alum factory. Illinois. R-1694.

**Civil or Mining Engineer.** Man who can use surveying instruments and who can plot his own notes. Must have had 1 or 2 years in the field. Coal-mine experience preferred. Salary \$150-\$175. Pennsylvania. R-1705.

**Mining Engineer** thoroughly experienced in gypsum, with knowledge of its location in United States and Canada. Buffalo, N. Y. R-1717.

**Manufacturing Executive.** Extensive experience in manufacturing line such as would qualify man to handle manufacture of plaster board, steel-mill experience of advantage. Buffalo, N. Y. R-1718.

**Department Head.** Mechanical engineer with paper-mill; board-mill, or steel-mill experience, capable of taking charge of department in paper mill. Buffalo, N. Y. R-1719.

**Metallurgical Engineer.** Graduate of a school of mines and familiar with heat treatment of steel. Position with eastern tool manufacturing concern; good future. R-1789.

**Editorial Work.** Recent graduate; education as metallurgical, mining, or mechanical engineer and ability to write. Knowledge of type and makeup of magazines gained in work on a college publication would be of advantage. Knowledge of iron and steel and machine shop practice also desirable. New York. Salary \$25 per week. R-1639.

**Metallurgical Chemist.** Actual thorough experience in white-metal smelting in reverberatory and blast furnace; must have reputation of highest order. New Jersey. R-1806.

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## ENGINEERING AND MINING JOURNAL AND THE PRINTERS' STRIKE

As the radical element has secured control of the various local printers' unions of New York City, 250 magazines have temporarily suspended publication rather than grant their demands. The actions of these local unions have been repudiated by the officers of the different international unions, who are seeking in every way to carry out their agreements with the publishers. The charters of the local pressmen's and feeders' unions have been revoked by the international officers and new local unions are being formed. Members of the typographical union are not, as yet, directly affected by the strike, but many of them are taking "vacations," which accomplishes the same purpose as the strike but without the odium.

The *Engineering and Mining Journal*, with true engineering spirit refusing to admit insuperable obstacles, is sending out a two-page printed market bulletin, together with two typewritten pages, making an announcement of its predicament and giving brief items of mining news. Thus is brought home to the members of the mining profession in a very direct way the pernicious results of unrestrained control of labor organizations by foreign and un-American elements. No sermon on this subject is required, as the facts themselves are sufficiently eloquent.

## PERSONAL

The following is an incomplete list of members and guests who called at Institute headquarters during the period Sept. 10, 1919, to Oct. 10, 1919.

|  |   |
|--|---|
| L. D. Anderson, Salt Lake City, Utah.        | P. S. Matthews, Newark, N. J.                   |
| Ray J. Barber, New York City.                | A. Poole Maynard, Atlanta, Georgia.             |
| L. A. Barton, Major U. S. Engineers.         | L. J. Mayreis, Jamshedpur, India.               |
| J. A. Battle, Chicago, Ill.                  | Benj. L. Miller, Bethlehem, Pa.                 |
| R. W. Bissell, New York City.                | Geo. D. Morgan, Bartlesville, Okla.             |
| Gilman E. Brown, Shanghai, China.            | A. C. Munroe, El Paso, Texas.                   |
| Stanley Brown, Chuquicamata, Chile,<br>S. A. | Paul I. Norton, Jr., Columbus, Ohio.            |
| Norman Carmichael, Clifton, Arizona.         | Walter G. Perkins, Stanford University,<br>Cal. |
| Richard H. Catlett, Newark, N. J.            | Fred S. Porter, Seattle, Wash.                  |
| Roderic Crandall                             | Charles E. Prior, Cherry Creek, Nevada          |
| John J. Croston, Atlanta, Georgia.           | G. M. Richards                                  |
| I. N. Dally, Seattle, Wash.                  | Gilbert Rigg, Melbourne, Australia.             |
| A. Faison Dixon, New York City.              | Pierre H. Sauvajol, Paris, France.              |
| Walter Dobbins, Springfield, Ill.            | Carl Scholz, Chicago, Ill.                      |
| Foss E. Douglass, Rancagua, Chile.           | Ellsworth H. Shriver, Marysville, Ohio.         |
| H. S. Emlaw, Grand Haven, Mich.              | Harvey B. Small, Magangué, Colombia.            |
| R. S. Everet, Barre, Mass.                   | Henry B. Smith, New Britain, Conn.              |
| H. W. Gipp, Melbourne, Australia.            | J. T. Smoody, Cornwall, Pa.                     |
| F. A. Glass, Brainerd, Minn.                 | S. J. Speak, London, England.                   |
| C. D. Grier, New York City.                  | D. R. Thomas, New York City.                    |
| James L. Head, Rancagua, Chile.              | Kirby Thomas, New York City.                    |
| Geo. B. Holderer, New York City.             | R. M. F. Townsend, Washington, D. C.            |
| W. Spencer Hutchinson, Boston, Mass.         | Carl J. Trauerman, Helena, Mont.                |
| Henry Jequier, Paris, France.                | A. C. Veatch, London, Eng.                      |
| L. W. Kemp, Chuquicamata, Chile.             | Myron R. Walker, Pittsburg, Pa.                 |
| Herbert S. Kohlberg, El Paso, Texas.         | Curtis C. Webb, New York City.                  |
| H. M. LaFollette, La Follette, Tenn.         | James Wilding, San Francisco, Cal.              |
| Richard Lamb, New York City.                 | S. H. Zimmerman, New York City.                 |

A. W. Allen, formerly with the *Engineering and Mining Journal*, has removed to Antofagasta, Chile.

Rolland Craten Allen has resigned as state geologist of Michigan, and has removed to Cleveland, Ohio, where he is connected with the Lake Superior Iron Ore Association, whose offices are in the Rockefeller Building.

Stephen O. Andros has removed from Albuquerque, N. Mex., to Chicago, Ill., and is now with the *Oil News*.

Daniel Boyd has accepted a position in connection with research on non-ferrous alloys, in the Metallurgical Department of Queen's University, Kingston, Ont.

Spruille Braden has returned from Chile and is now at 19 West 44th St., New York City.

D. L. Cleaves, of St. Louis, has accepted a position with the Balbach Smelting and Refining Co., at Newark, N. J.

James C. Dick has removed from Salt Lake City to Washington, D. C.

Robert Henry Dott has removed from Bartlesville, Okla., to Ann Arbor, Mich.

Fred W. Draper, formerly of Mountain Lakes, N. J., has accepted a position with the Louisiana Cons. Mining Co., Tonopah, Nev.

**Daniel M. Drummheller, Jr.**, has resigned his position with the Red Monarch Mine, Carbonite, Ida., and is now located at 401 Columbia Building, Spokane, Wash.

**Dan M. Duncan** has removed from Oakland, Calif., to Jerome, Ariz.

**D. D. Dunkin** has removed from Webb City, Mo., to Baxter Springs, Kans.

**Alfred K. Friedrich** has resigned his position with the Buckeye Coal Co., at Nemacolin, Pa., and has accepted the position of associate professor of mining at Iowa State College.

**Clyde T. Griswold** has accepted a position as mining engineer with the Santa Fe Railroad Co., with headquarters at Oklahoma City, Okla.

**John S. Harris**, formerly of Carthage, Mo., is now located at Klondyke, Graham Co., Ariz., where he is connected with the Aravaipa Leasing Co.

**James L. Head**, recently discharged from the service, has accepted a position with the Braden Copper Co., at Rancagua, Chile.

**Frank A. Herald** has removed from Lexington, Ky., to Washington, D. C., where he is chief of valuation engineers, Oil and Gas Section, of the Bureau of Internal Revenue.

**Barry Hogarty**, recently chemist with the United Verde Extension Mining Co., at Jerome, Ariz., is now located at Denver, Colo.

**Hugh C. Ingle** has been appointed district engineer with the Oregon State Highway Commission, with headquarters at The Dalles, Oregon.

**J. L. James**, lately of Sego, Utah, has been made superintendent of the Victor American Fuel Co., at Chandler, Colo.

**Frederick K. Kett**, until recently with the New York Shipbuilding Corp., at Camden, N. J., is now employed by the Compania de Minas de Fierro las Truchas, at Manzanillo, Mexico.

**Stuart C. Lawson**, formerly of Madison, Wis., is now connected with the sales department of the Otis Elevator Co. in New York, as chief estimating engineer.

**Jeremias H. Ledeboer**, formerly with the Broken Hill Proprietary Co., Ltd., in Australia, who has been spending several months in this country, has gone to The Hague, Holland.

**Capt. Donald M. Liddell** has again taken up his work of chemical engineering in Rooms 1800-1802, 66 Broadway, New York City, where he is prepared to develop processes and investigate industrial plants for bankers. His laboratory is at 961-965 Frelinghuysen St., Newark, N. J.

**Walter W. Lytzen**, formerly of Interstate, Ida., has accepted a position with the Big Ledge Copper Co. at Huron, Ariz.

**Edwin Ludlow**, until recently vice-president of the Lehigh Coal & Navigation Co., has opened an office at 149 Broadway, New York, as consulting engineer, specializing in coal and coke.

**Frank A. Manley** has been elected vice-president of the O'Gara Coal Co. and has removed from Rock Springs, Wyo., to Chicago.

**William E. Milligan**, formerly with the United States Metals Refining Co. at Chrome, N. J., is now connected with the Department of Metallurgy at Toronto University.

**M. H. Newman** has removed from Plattesville, Wis. to Knoxville, Tenn.

**Will V. Norris** has accepted a position as assistant professor of chemistry at Texas Christian University, Fort Worth, Tex.

**Arthur Phillips** has resigned his position as metallurgist at the Bridgeport Brass Co. to become assistant professor of metallurgy at Yale University.

**H. N. Read** has removed from Rapid City, S. D. to Denver, Colo., where he has accepted a position with Camp Bird, Ltd., to do special metallurgical work.

**E. Roger**, previously residing at Nessonvaux, Belgium, has gone to Elisabethville, Congo Belge, South Africa, where he is in the employment of the Union Miniere du Haut Katanga.

**Douglas R. Semmes** has taken charge of the department of geology at the University of Alabama. His associate, Dr. J. S. Grasty, will carry on the business of Grasty & Semmes, with headquarters at Fort Worth, as heretofore.

**Lyon Smith**, of Brookline, Mass., has been made superintendent of the York Ferro-Alloys Co. of York, Pa. This company expects to complete construction and to begin operations about Nov. 1.

**J. Edward Spurr**, formerly mining geologist at Washington, D. C., has recently been appointed editor of the *Engineering and Mining Journal*.

**John S. Stewart**, formerly of West Mansfield, Ohio, is now with the Kingdon Mining, Smelting & Mfg. Co., Galetta, Ont.

**George C. Stone** returned the first of October from a three months trip abroad.

**Herbert G. Thomson** has been elected a director of the Nevada Packard Mines Co., Lower Rochester, Nev., but retains his position as general superintendent.

**Arthur L. Tuttle**, general manager for the Tennessee Copper Co., at Copperhill, Tenn., has been transferred to their New York office and appointed consulting engineer.

**Arthur E. Wells**, who has been connected with the Washington office of the Bureau of Mines, has been transferred to the office at the University of Utah, Salt Lake City.

**O. W. Wheeling**, recently with the Michigan Geological Survey at Lansing, Mich., is now connected with the Ramapo Ore Co., at Sterlington, N. Y.

**William C. White**, until recently mining engineer with the Weedon Mining Co., at Weedon, Ont., has accepted a position with the Cia. Santa Gertrudis, at Pachuca, Mexico.

**J. R. Wilkinson**, lately discharged from the service, has returned to the Anaconda Copper Mining Co., at Anaconda, Mont.

**Edward I. Williams**, who before entering the army was in the New York office of the General Chemical Co., has been transferred to Monarat, Va., and appointed superintendent of the works there.

**H. C. Wilmot** has removed from Bland, New Mex., to Los Angeles, Calif.

**Robert H. Wood**, formerly in Washington, D. C., is now located at 516 Daniel Building, Tulsa, Okla.

**Hayes W. Young**, formerly assistant professor of metallurgy at Stanford University, has accepted a position as research engineer for the casing-head gas department of the Midwest Refining Co., with headquarters at Salt Lake City, Utah.

# MEMBERSHIP

## NEW MEMBERS

The following list comprises the names of those persons who became members during the period Sept. 10, 1919, to Oct. 10, 1919.

- ADAMS, R. L. . . . . Chief Min. Engr., Old Ben Coal Corpn., Mine 12, Christopher, Ill.  
 ARIZUMI, HIROSHI. . . . . The Kuhara Min. Co., Ltd., Tokyo, Japan.  
 BAILY, T. F. . . . . Pres. & Gen'l Mgr., Electric Furnace Co., Alliance, O.  
 BALDWIN, A. J., Min. Engr. . . . . Box 145, Pikeville, Kentucky.  
 BALTZELL, WILL H., Chief Engr., Canadian Steel Corpn., Ltd.,  
 Ojibway, Essex Co., Ont., Canada.  
 BANON, E. MAGAWLY, Examining Engr., Dawes Bros., Inc.,  
 108 So. LaSalle St., Chicago, Ill.  
 BARNES, W., Mech. Engr., Excavating Dept., Ruston & Hornsby, Ltd.,  
 Lincoln, England.  
 BASHORE, E. GORGAS, Head Chem., The Babcock & Wilcox Co., Bayonne, N. J.  
 BASS, A. L. . . . . Supt., Hobson Silver Lead Co., Ltd., Ymir, B. C., Canada.  
 BORN, SIDNEY, Chief Chem., Empire Gas & Fuel Co. & Associated Companies,  
 1100 Cherokee Ave., Bartlesville, Okla.  
 BRADLEY, J. G., Coal Operator, Pres. & Gen'l Mgr., Elk River Coal & Lumber Co.,  
 Dundon, W. Va.  
 BENNETT, G. W., Min. Engr., Sales Engr., Taylor-Wharton Iron & Steel Co.,  
 High Bridge, N. J.  
 BRUFF, CHARLES E., Member firm Bradley, Bruff & Labarthe, .  
 85 Second St., San Francisco, Cal.  
 COLLINS, FRANK W., Chief Engr., Bradley, Bruff & Labarthe,  
 85 Second St., San Francisco, Cal.  
 CONNELL, F. M., Min. Engr., Eastern Min. & Mill. Co., Ltd.,  
 905 Bank of Hamilton Bldg., Toronto, Ont., Canada.  
 COOK, HARRY H., Vice-pres., Valley Mould & Iron Corpn.,  
 137 Shenango St., Sharpsville, Pa.  
 CRANDALL, HECTOR, Cons. Geol., Crandall & Murta, 322 Kennedy Bldg., Tulsa, Okla.  
 DAHLGREEN, PAUL F., Oil, Gas & Gasoline Producer, Box 968, Bartlesville, Okla.  
 DETHLOFF, WILLIAM LOUIS, Chief Engr., The Mond Nickel Co., Ltd.,  
 Coniston, Ont., Canada.  
 DILLER, J. S. . . . . Geol., U. S. Geological Survey, Washington, D. C.  
 DILLINGHAM, GEORGE B., Chief Engr., Cerro de Pasco Copper Corpn.,  
 Morococha, Peru, S. A.  
 DOLLISON, JAMES E., Min. Engr., Proprietor, Alma Assay Office, Alma, Park Co., Colo.  
 DUNCAN, WILLIAM R. . . . . Geol., Ray Consolidated Copper Co., Ray, Ariz.  
 DYER, BERT W. . . . . U. S. Bureau of Mines, Rescue Car No. 5, Butte, Mont.  
 EVANS, W. S., Sec'y, Lucey Mfg. Corpn., 2328 Woolworth Bldg., New York, N. Y.  
 FEES, L. V., Division Geol., Mont.-Wyo. Division, The Texas Co.,  
 517 First National Bank Bldg., Denver, Colo.  
 FISHER, H. A., Gasoline Engr., H. A. Fisher Co.,  
 1014-18 House Bldg., Pittsburgh, Pa.  
 FLINN, ALFRED R. . . . . Min. Engr., Empire Zinc Co., Hanover, New Mex.  
 FORAN, JACK HENRY, Min. Engr., Maatschappij tot Mijn-Bosch-en Landbouw-  
 exploitatie in Langkat, Rantau Pandjang, Tandjong Poera,  
 Sumatra, O. K., D. E. I.  
 FOSLIE, STEINAR, Min. Engr., State Min. Geol., Geological Survey of Norway,  
 Kronprinsens St. 10, Kristiania, Norway.  
 GAFFNEY, JOSEPH B., District Mgr., Fuller Engrg. Co.,  
 Room 719, Sheldon Bldg., San Francisco, Cal.  
 GAWTHROP, ROBERT M., Chief Geol., The Ohio Cities Gas Co., Box 1881, Tulsa, Okla.  
 HANSEN, CLINTON J. . . . . Engr., W. A. Clark Interests, 411 W. Park St., Butte, Mont.  
 HENNING, JOHN L., Cons. Engr., General Practice,  
 525 Kirby St., Lake Charles, Louisiana.  
 HILL, HARRY PEARSALL, Min. Engr., Arizona Copper Co., Ltd.,  
 Box 542, Morenci, Ariz.  
 HOFFER, T. B., Gen'l Supt., Northern Division, Humble Oil & Refin. Co.,  
 Fifth Floor, Dan Waggoner Bldg., Fort Worth, Texas.

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS xlix

- JANITZKY, EMANUEL J. . . . . Met. Engr., Illinois Steel Co., So. Chicago, Ill.  
 JONES, JOHN DONALD, Cons. Min. Engr.,  
 306 2d National Bank Bldg., Wilkes Barre, Pa.  
 KEARNS, E. J., Electro-met., Gen'l Supt., National Carbide Corp., Ivanhoe, Va.  
 KISSOCK, ALAN, Min. & Met. Engr., Steel Alloys Co.,  
 1023 Investment Bldg., Los Angeles, Cal.  
 KOPKE, HARRY C., Met., White & Bro., Inc.,  
 412 N. American Bldg., Richmond & Hedley Sts., Philadelphia, Pa.  
 KNOWLES, A. S., Mgr., The Consolidation Coal Co.,  
 686 East Catalan St., St. Louis, Mo.  
 LEVAN, LLOYD A., District Engr., Lehigh Coal & Navigation Co., Lansford, Pa.  
 LINCOLN, PAUL. . . . . Mgr., Noble Five Mine, Sandon, B. C., Canada.  
 MAGOUN, J. W., Asst. Engr. of Tests, Steelton Plant, Bethlehem Steel Co.,  
 Steelton, Pa.  
 MARKMAN, B. G., Prof. of Min. Engrg., Royal School of Mines, Stockholm, Sweden.  
 MARTIN, HAROLD S., Chief Chem., Arthur Plant, Utah Copper Co.,  
 Salt Lake City, Utah.  
 MERCER, HUGH. . . . . Min. Engr., Big Muddy Coal & Iron Co., Herrin, Ill.  
 MEYERS, PAUL W., Min. Engr., Mining Development Co.,  
 2030 Land Title Bldg., Philadelphia, Pa.  
 MOLE, WILLIAM T., Min. Engr., Transvaal Consolidated Land & Exploration Co.,  
 Groenfontein Tin Mines, Potgietersrus, Transvaal, So. Africa.  
 MORRIS, W. REED. . . Asst. Supt., Seaboard By-product Coke Co., Jersey City, N. J.  
 MURRAY, J. B., Surveyor & Draftsman, . . . . . 307 Tajo Bldg., Los Angeles, Cal.  
 PETERSON, F. H. . . . . Met. & Chem., Heller Bros. Co., 19 Cottage St., Newark, N. J.  
 PRINGLE, O. L. . . . . Asst. to Gen'l Supt., Cambria Steel Co., Johnstown, Pa.  
 OLIVEIRA, JOSÉ DE PAIVA, Cons. Min' Engr., Mgr. & Owner, Zirconia & Manganese  
 Mines, 31, Rua Bahia, Pocos de Caldas, Minas Geraes, Brazil.  
 ORR, THOMAS W., Chem. . . . . Care of Robert Bell, Antofagasta, Chile, S. A.  
 PETKOSKI, THOMAS. . . . . Cons. Supt., Lehigh Coal & Navigation Co., Lansford, Pa.  
 RICE, OWEN R., Blast Furnace Met., Bethlehem Steel Co.,  
 424 N. New St., Bethlehem, Pa.  
 RICHARDS, M. E. . . . . Gen'l Mgr., Judson Min. Co., Crystal Falls, Mich.  
 ROBIE, EDWARD H., Met. Engr., Asst. Editor, Engrg. & Min. Journal,  
 McGraw-Hill Co., 10th Ave. & 36th St., New York, N. Y.  
 ROEBLING, KARL G. . . . . Pres., John A. Roebling's Sons Co., Trenton, N. J.  
 ROLFE, W. J., Underground Supt., International Nickel Co.,  
 Creighton Mine, Ont., Canada.  
 ROTH, CHARLES F., Mgr., National Exposition of Chem. Industries,  
 Grand Central Palace, New York, N. Y.  
 SMAIL, JAMES A. . . . . Met., Republic Iron & Steel Co., Youngstown, O.  
 SNYDER, GRANT, Pres. & Mgr., Eureka Lilly Min. Co.,  
 Judge Bldg., Salt Lake City, Utah.  
 TATSUNO, MASAYUKI, Met. Engr., Sumitomo Besshi Copper Mine,  
 Shisakajima Copper Works, Ochigun, Iyo, Japan.  
 THOM, CLARENCE, Met., Supt. Magnetic Test Mill,  
 Consolidated Min. & Smelt. Co. of Canada, Ltd., Trail, B. C., Canada.  
 TRIPP, CHESTER D., Member of firm of Brassert, Hardy & Tripp,  
 943 Peoples Gas Bldg., Chicago, Ill.  
 VAN GOGH, F. A. A., Min. Engr. & Pet. Geol., Bataafsche Petroleum Maatschappij,  
 30 Carel van Bylandtlaan, The Hague, Holland.  
 WALMSLEY, WALTER NEWBOLD, Gen'l Mgr., Alabama Power Co., Birmingham, Ala.  
 WITTING, ALBIN G., Chief Draftsman, Illinois Steel Co., Gary Works, Gary, Ind.  
 WOOLF, JOE H., JR., Asst. Ore Appraiser & Surveyor, Seoul Min. Co.,  
 Tul Mi Chung, Chosen, Korea.

## Associates

- BAIRD, R. E. . . . . Supt., Bertha A. Min. Co., 605 Daugherty St., Webb City, Mo.  
 BROWN, FRED, Mine Foreman, American Smelt. & Refin. Co.,  
 Angangueo, Michoacan, Mexico.  
 CARLSON, MONROE OLIVER, Min. Engr., Resident Engr. & Gen'l Inspector,  
 Colorado Division, Utah Fuel Co., Somerset, Colo.  
 CLARK, CLIFFORD K., Engr., New York Orient Mines Co.,  
 Room 1507, 14 Wall St., New York, N. Y.  
 COLE, HENRY AMBROSE, Min. Engr., Shippers Commercial Corp., Shanghai, China.

- CRAIG, ERIC KENNETH, Engr. to Pato Mines, Ltd.,  
Apt. 104, Barranquilla, Columbia, S. A.
- EMILIO, S. GILBERT, Min. Engr., Utah-Apex Min. Co., Bingham Canyon, Utah.
- FIELD, BURNHAM E., Research Met., Electro Metallurgical Co.,  
702 Buffalo Ave., Niagara Falls, N. Y.
- GRAY, JOHN PINKHAM, Attorney at Law, Coeur d'Alene, Idaho.
- HUBBARD, B., Geol., Dept. of Geol., Columbia Univ., New York, N. Y.
- KANEKO, EJURO, Foreman, Ashio Copper Mine, Tochigiken, Japan.
- KIRBY, GRADY, Pet. Geol., Roxana Petroleum Co. of Oklahoma,  
Box 82, Mineral Wells, Texas.
- MYERS, ALFRED, Min. Engr., 109 Hillcrest Road, Berkeley, Cal.
- SHEPHERD, B. FRANKLIN, Met., Ingersoll-Rand Co., Phillipsburg, N. J.
- SMOLEY, EUGENE R., Chem. Engr., New Jersey Zinc Co., Palmerton, Pa.
- STEWART, A. M., Factory Mgr., The National Supply Co.,  
2159 Scottwood Ave., Toledo, Ohio.
- TRIMBLE, RALEIGH P., 85 Fourth St., Portland, Oregon.
- WHEELER, H. E., Research Engr., Box 1938, Boston, Mass.

### Junior Associates

- BOOKER, KARL WILLIAM, Student, Missouri School of Mines, Box 755, Rolla, Mo.
- BURDICK, SHERMAN R., Student, Univ. of California, Berkeley, Cal.
- CASSELL, CHARLES A., Student, Massachusetts Institute of Technology,  
Cambridge, Mass.
- GRUBB, EVERETT L., Student, Univ. of Wisconsin, Madison, Wis.
- HARVEY, ALEXANDER DUER, Student, Mass. Institute of Tech., Cambridge, Mass.
- ILLIDGE, ROBERT E., Student, Missouri School of Mines, Rolla, Mo.
- KERR, RICHARD CALDWELL, Pet. Geol., Care Western Union Oil Co.,  
Bicknell, Santa Barbara Co., Cal.
- KORVES, ALBERT A., Student, Lehigh Univ., So. Bethlehem, Pa.
- KUO, NAN, Student, Carnegie Institute of Tech., Pittsburgh, Pa.
- LEACH, THOMAS W., Student, Missouri School of Mines, Rolla, Mo.
- LEE, RICHARD, Student, Massachusetts Institute of Technology, Cambridge, Mass.
- LEWIS, ROBERT F., Student, Mass. Institute of Tech., Cambridge, Mass.
- MILLS, EDWIN LEWIS, Student, School of Mines, Univ. of Pittsburgh, Pittsburgh, Pa.
- NORVILLE, HOWARD O., Student, Missouri School of Mines, Box 100, Rolla, Mo.
- PERRY, ROBERT ALLEN, Asst. Met., Pope Shenon Min. Co. Salmon City, Idaho.
- PETSCHE, A. H., Missouri School of Mines, Rolla, Mo.
- PIERCE, WILBUR C., Chem., Anaconda Copper Min. Co., Anaconda, Mont.
- SHANNON, SPENCER S., Asst. Supt., Carbon Coal & Coke Co., Saxton, Bedford Co., Pa.
- STRATMOEN, A. N., Student, Carnegie Institute of Tech., Pittsburgh, Pa.
- SUN, TO SHUEN, Met., Lehigh Univ., So. Bethlehem, Pa.
- WEBB, ALBERT LOOMIS, Student, Missouri School of Mines, Box 759, Rolla, Mo.
- WILLIAMS, HAROLD SNOOK, Student, Univ. of California, Berkeley, Cal.

### Change of Status, Associate to Member

- ABEL, W. D., Min. Engr., Consolidated Coppermines Co., Kimberly, Nevada.
- BERGSTROM, FRANK S., Cascade Min. Co., Palmer, Mich.
- HILL, ROBERT S., Tshikapa, Kasai Diamond Fields, Congo Belge, W. Africa.
- LEEKE, DANA WINSTON, Care Richard Blamey,  
Toimura Idzu, Kitakagun, Shizuokaken, Japan.
- NEWCOMB, CLIVE W., Nitrate Industry, Casilla 232, Iquique, Chile.
- Total Membership Oct. 10, 1919 7684**

### Members' Addresses Wanted

- | Name                | Last address of Record from which Mail has been returned. |
|---------------------|---|
| ANDERSON, L. W.     | Boston Mine, Utah Copper Co., Bingham, Utah.              |
| ARMSTRONG, E. W.    | Mina Bibilonia, La Libertad, Nicaragua, C. A.             |
| BIRD, FRANK H.      | Butler Hotel, Seattle, Wash.                              |
| BREEDING, F. O.     | Eden Min. Co., Bluefields, Nicaragua.                     |
| BROWN, W. SINCLAIR. | Air Board Offices, Swansea, England.                      |
| CALLAN, ARTHUR S.   | 3510 N. 16th St., Philadelphia, Pa.                       |
| CAMPBELL, W. C.     | Care Ivanpoh Min. Co., Cima, Cal.                         |
| CARPENTER, E. LEON. | Box 397, Salisbury, Md.                                   |

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS li

|                                    |   |
|------------------------------------|---|
| CARROLL, GEORGE A.....             | Pacific Coast Borax Co., Ryan, Cal.                         |
| CRONIN, PAUL B.....                | 1453 Oak St., Glendale, Cal.                                |
| DETERT, WILLIAM F.....             | Jackson, Amador Co., Cal.                                   |
| DONAHOE, JOHN E.....               | Connecticut Zinc Corp., Oronogo Circle Mines, Oronogo, Mo.  |
| ESSLER, MANUEL.....                | Hong Kong Club, Hong Kong, China.                           |
| FLAHERTY, ROBERT H.....            | 74 King St., E., Toronto, Ont., Canada.                     |
| GLEASON, VILLEROY, JR.,            | Machinery Dept., Mine & Smelter Supply Co.,                 |
|                                    | 121-125 West 2d So. St., Salt Lake City, Utah.              |
| HERR, J. CAMPBELL.....             | Box 556, State College, Pa.                                 |
| HERZIG, C. S.....                  | Care George B. Herzig, 41 West 29th St., New York, N. Y.    |
| HOLMLIN, CARL A.....               | 845 Maple Ave., Los Angeles, California.                    |
| KAMMERER, CHARLES.....             | Box 412, San Francisco, Cal.                                |
| KING, FRANK E.....                 | Hotel Breslin, New York, N. Y.                              |
| KLINE, HARRY D.....                | Ray Cons. Copper Co., Ray, Ariz.                            |
| KLUGESCHIED, WALTER P.....         | 616 W. 13th St., New York, N. Y.                            |
| LEVAT, DAVID.....                  | 174 Blvd. Malesherbes, Paris, France.                       |
| MCCRAY, H. E.....                  | Humboldt, Ariz.   |
| MCINTYRE, JOHN E.....              | Ocean Park, Cal.  |
| MCINTOCK, A.....                   | Hermon, St. Lawrence Co., N. Y.                             |
| MATTHIAS, MAXIMILIAN PAUL, Lieut., | Ordnance Dept., U. S. A.                                    |
|                                    | 194 Nesmith St., Lowell, Mass.                              |
| MILES, J. H.....                   | Gen'l Supt., Alaska Mines Corp., Nome, Alaska.              |
| MINISTER, H. L.....                | The Empire Zinc Co., Kelly, N. Mex.                         |
| NAHL, A. C.....                    | 1079 Monadnock Bldg., San Francisco, Cal.                   |
| NIEMAN, HENRY W.....               | 27 West 44th St., New York, N. Y.                           |
| PORTER, JAMES CLARKE, Mgr.,        | Coal Exploration Dept., E. J. Longyear Co.,                 |
|                                    | 413 National Bank of Commerce Bldg., St Louis., Mo.         |
| ROWE, FREMONT S.....               | Supt., Hecla Mine, Burke, Idaho.                            |
| SCHNEPP, C. F.....                 | 307 S. Club Walk, Pennsgrrove, N. J.                        |
| SHEDDEN, JOHN S.,                  | The Mine & Smelter Supply Co., 42 Broadway, New York, N. Y. |
| STICKNEY, WILLIAM H.....           | 708 N. Center St., Reno, Nev.                               |
| TINGLEY, T. W.....                 | Beutree, W. Va.   |
| WOO, W. K.....                     | M 70 Sing Kong Li, Minghong Road, Shanghai, China.          |
| WRIGHT, FREDERICK S.....           | Supt., Butte & Great Falls Min. Co., Neihart, Mont.         |

## NECROLOGY

The deaths of the following members were reported to the Secretary's office during the month Sept. 10, 1919, to Oct. 10, 1919.

| Date of Election. | Name.                 | Date of Death.  |
|-------------------|-----------------------|-----------------|
| 1914              | Bigelow, Braxton..... | July 23, 1917.  |
| 1889              | Dickman, R. N.....    | Sept. 14, 1919. |
| 1883              | Waller, Elwyn.....    | July 6, 1919.   |
| 1892              | Wilkins, H. A. J..... | Sept. 13, 1919. |

## CANDIDATES FOR MEMBERSHIP

**APPLICATION FOR MEMBERSHIP.**—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any persons whom they think should not be classified in accordance with the list given.

### *Applications Lacking Endorsement*

Applications for membership have been received from Mr. Humenry and Mr. Sorenson, whose records are given below. These applications lack the necessary number of endorsers, but since these candidates live at some distance from the headquarters of the Institute, their records are published here in order that any members who are acquainted with

them may be advised of the circumstances and may have an opportunity of writing to the Secretary endorsing these candidates.

**Joseph Humenry**, Douai, France.

Present position—1918 to date: Director of the service of grouping the colliery victims of the invasion.

Proposed by Arthur H. Wethey.

Born 1874, Aurillac, France. 1911-17, Engr. of Mines in Dasreville & Anrin. 1907-14, Principal Engr. of Mines of Liévin. 1914, Chief Engr. of Mines of Liévin.

**James Sorenson**, Clintonville, Wis.

Present position—1918 to date: Met. Engr., Four Wheel Drive Auto Co.

Proposed by

Born 1890, Racine, Wis. 1908-09, Racine College of Commerce. 1910-12, Chicago Technical College. 1915, Iron & Steel Analysis, Marquette Univ. 1914-17, Met., Gemco Mfg. Co., Milwaukee, Wis. 1917-18, Engr. of Tests, Cannon Forgings, U. S. Army.

The following persons have been proposed during the period Sept. 10, 1919, to Oct. 10, 1919, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

### Members

**David Harold Abrams**, Johnstown, Pa.

Present position—1917 to date: Min. & Cons. Engr. & Vice-pres., S. E. Dickey & Co.

Proposed by M. G. Moore, George J. Krebs, H. M. Kanarr.

Born 1883, Morris Run, Pa. 1889-94, Lindsey Public Schools, Pa. 1894-97, Johnstown Public Schools, Pa. 1900-03, Internatl. Corres. Schools. 1903-04, Transitman & Asst. Min. Engr., Lackawanna Coal & Coke Co., Wehrum, Pa. 1904-06, Min. Engr., Berch Creek Coal & Coke Co., Arcadia, Pa. 1906-08, Min. Engr. & Chief Engr., Russell Coal Min. Co., Clymer, Pa. 1908-10, Min. Engr., Cambria Steel Co., Johnstown, Pa. 1910-12, Min. Engr. & Supt. of Mines & Coke Plant, Saxman Coal & Coke Co., Saxman, W. Va. 1912-13, Asst. Supt. of Mines, Jefferson & Clearfield Coal & Iron Co., Ernest, Pa. 1913-14, Supt. of Mines, Jefferson & Clearfield Coal & Iron Co., Hultman, Pa. 1914-17, Min. Engr., S. E. Bickey & Co., Johnstown, Pa.

**William Lewis Affelder**, Pittsburgh, Pa.

Present position: Asst. to the Pres., Hillman Coal & Coke Co., Clarksville Gas Coal Co., Luzerne Coal & Coke Co., Belle Vernon Coke Co.

Proposed by M. D. Cooper, W. E. Fohl, H. H. Stoeck.

Born 1879, Pittsburgh, Pa. 1885-93, Allegheny Public Schools. 1893-95, Allegheny High School. 1895-99, Pa. State College, B. S. 1899, summer, Draftsman, H. C. Frick Coke Co., Scottdale, Pa. 1899-1900, Asst. Engr., Vinton Colliery Co., Vintondale, Pa. 1900-06, Supt., Mosgrove Coal Wks., Mosgrove, Pa. 1906, Gen'l Mgr., Mine LaMotte Lead & Smelt. Co., Mine LaMotte, Mo. 1906, Engrg. business for self. 1906, Supt., Merchants Coal Co., Boswell, Pa. 1907-12, Supt., H. C. Frick Coke Co., Brownfield, Pa. 1912-13, Gen'l Mgr., Bulger Block Coal Co., Bulger, Pa. 1913 to date, with coal & coke operations of J. H. Hillman & Sons Co., as Gen'l Mgr. & Asst. to Pres.

**Andrews Aller**, Chicago, Ill.

Present position—1911 to date: Pres. & Treas., Aller & Garcia Co.

Proposed by Eugene McAuliffe, Carl Scholz, George B. Harrington.

Born 1871, Madison, Wis. 1887, Madison, Wis., High School. 1891, Univ. of Wis., B. C. E. 1891-99, Asst. Engr., Edge Moon Bridge Wks. 1899-1911, Concentrating Engr., Wis. Bridge & Iron Co.

**Arthur Robert Andrew, Sarawak, Borneo.**

Present position—1912 to date: Geol., Anglo-Saxon Pet. Co.

Proposed by Colin Fraser, W. Gibson, Gilbert Rigg.

Born 1881, Otago, New Zealand. 1900-04, Otago Sch. of Mines, New Zealand. 1904-06, Univ. of Birmingham, England, M. S. 1910, Doctor of Science, New Zealand. 1906-09, Principal Min. Surveyor, Colonial Office and Imperial Institute, Nyasaland Protectorate, C. A. 1909-12, Examining oil concessions in Columbia, S. A. Cohen Laming & Goschen, London.

**Ray Walter Arms, Urbana, Ill.**

Present position—1917 to date: Instr., Dept. of Min. Engrg., Univ. of Ill.

Proposed by H. H. Stoek, J. Burns Read, J. R. Fleming.

Born 1890, Muskegon, Mich. 1908-12, Ohio State Univ. 1918-19, Univ. of Ill., E. M. 1912, Engr. & Chem., Republic Iron & Steel Co., Republic, Pa. 1913-14, Met., Cleveland & Weatherhead, Mogollon, N. M. (Acting Supt. of Mill for 6 wk.) 1914-15, Chem., Engr., Welfare Supt., Republic Iron & Steel Co., Republic, Pa. 1915, Engr., Dravo Contr. Co., Donora, Pa. 1915-16, Prospecting in Southern Calif. 1916, Partnership with J. E. Lady, Blythe, Calif. 1917, Independent assay & engrg. office, Wenden, Ariz. 1917, Asst. Dept. of Met., Ohio State Univ., Columbus, Ohio. 1918, Charge of erection of Dorr Engrg. Co. Equipment, Explosives Plant "C," Nitro, W. Va.

**Leighton Macdonald Arrowsmith, New Canaan, Conn.**

Present position—1918 to date: Shift Boss, Knights Deep Smelt. Min. Co. Ltd.

Proposed by Arthur S. Dwight, Reed W. Hyde, H. Stehli.

Born 1887, Bergen Point, N. J. 1899-1905, St. George's School. 1905-09, Harvard Univ. 1910-11, Cambridge Univ., A. B. 1907, Surface work, Duchess Silver Min. Co., Cobalt, Ont., Canada. 1908, Trimming & stoping, Silver Queen Mines, Cobalt, Ont., Canada. 1909-10, Charge of prospecting parties & surface work, Elk Lake silver districts. 1910, Surface & underground work, Waldman silver mines, charge prospecting & development work, A91 Min. Co. Ltd., Cobalt, Canada. 1911-12, Underground Learner; 1912, Sampler. 1912-15, Shift Boss, Knights Deep S. M. Co. Ltd., Transvaal, So. Africa. 1915-16, Mgr., Chin mine, Mt. Darwin, Southern Rhodesia. 1916-17, Shift Boss, Knights Deep S. M. Co. Ltd. 1917-18, Shift Boss, Nourse Mines Ltd., Transvaal, So. Africa.

**Ernest Lawrence Bailey, Orinoco, Ky.**

Present position—1916 to date: Supt., Solvay Collieries Co.

Proposed by Thomas H. Clagett, Henry Brooke, W. H. Cummins.

Born 1888, Matoada, W. Va. 1901-05, Princeton H. S. 1905-08, Va. Poly. Inst. 1908-16, Chief Engr., United Pocahontas Coal Co.

**Francis William Bailey, Gary, W. Va.**

Present position: Div. Engr., U. S. Coal & Coke Co.

Proposed by Howard N. Eavenson, R. J. Holden, Otto C. Burkhardt.

Born 1886, Winchester, Va. 1907-09, Shenandoah Valley Military Academy, Va. 1911-16, Virginia Poly. Inst., Blacksburg, Va., E. M. 1913, summer, Worked up data for contract wk., underground mining, Alleghany Ore & Iron Co., Lignite, Va. 1914, summer, Transitman, Ashby Merrill, Blacksburg, Va. 1915-16, Asst. Geol., Va. Poly. Inst., Blacksburg, Va. 1916-17, Asst. Engr., U. S. Coal & Coke Co., Gary, W. Va. 1917-18, Lieut., Engrs., U. S. A.]

**Alfred J. Balmforth, Warren, Ariz.**

Present position—1916 to date: Engr., Calumet & Ariz. Min. Co.

Proposed by D. M. Rait, Ira B. Joralemon, E. E. Whiteley.

Born 1882, Salt Lake City, Utah. 1900-04, Mont. Sch. of Mines, E. M. 1904-05, Underground experience & mill wk., Butte, Mont. 1905-06, Gen'l eng. wk., Smith Engrg. Co. 1906-09, Geol., Geol. Survey Dept., C. & A. Min. Co., Bisbee, Ariz. 1909-10, Asst. Supt., San Antonio Copper Co., Sonora, Mex. 1910-12, Gen'l Engrg.; 1916-19, Min. Engr., Calumet & Ariz. Min. Co.

**Royce Elwin Barlow, St. Louis, Mo.**

Present position: Chem. & Supt., Oil Dept., United Ry. Co., St. Louis, Mo.

Proposed by Edwin C. Reeder, J. D. Robertson, J. H. Campbell.

Born 1878, Hastings, Mich. 1896, Mich. College of Mines, E. M. 1898-1904, Assayer, Chem., Engr., various companies from Mont. to Ariz, with Anaconda Copper Co. 1904-07, Asst. Gen'l Mgr., C. P. Copper Son Ry. Co., St. Louis, Mo. 1907-15, Chem., Edgar Zinc Co., St. Louis, Mo. 1915-16, Mississippi Valley Iron Co., Wankon, Ill.

**Wesley J. Beck**, Middletown, O.

Present position—1903 to date: Director of Research, American Rolling Mill Co  
Proposed by Allerton S. Cushman, Charles R. Hook, J. H. Frantz.

Born 1875, La Fayette, Ind. 1896, Purdue Univ., Ind., B.S. 1897-1905, Testing Dept. & Engrg. Dept., Westinghouse Elec. & Mfg. Co. 1903 to date, Supt., Elec. Dept., Director Research (Chem., Elec., Met.), Amer. Rolling Mill Co., Middletown, O.

**William Fay Boericke**, Galena, Ill.

Present position—1910 to date: Min. Engr., Mineral Point Zinc Co.

Proposed by Arthur Thacher, J. H. Polhemus, J. A. Van Mather.

Born 1884, San Francisco, Calif. 1902-05, Harvard College. 1909, Columbia School of Mines, A. B.

**Alexander Henry Bradford**, Seattle, Wash.

Present position—1917-19: Supt., Shumagin Packing Co., S. Bellingham, Wash.

Proposed by Charles E. Locke, Carle R. Hayward, H. O. Hofman.

Born 1884, Alameda, Calif. 1904-08, Mass. Inst. Tech., S. B. 1909-10, Supt., Chignik Coal Min. Co. 1911-16, Engrg. wk., Northwestern Fisheries Co., Alaska Packers Assn., Pacific American Fisheries, and others.

**Francis Dean Bradley**, Goldfield, Nev.

Present position: Mill Supt., Goldfield Devel. Co.

Proposed by Edson S. Pettis, Jay A. Carpenter, H. L. Huston.

Born 1883, Utica, N. Y. 1901-05, Univ. of Nev., B. S. 1905-07, Odd jobs as Assayer, Miner, Prospector & Magazine Corres. 1907-08, Supt., Sierra Mazuma Min. Co., Seven-Troughs, Nev., mine lease. 1908-09, Civil Engr., Nev. Calif. Power Co., Draftsman, L. A. R. Ry. Co. & Santa Fe R. R. 1909-10, Assayer & Met., Llanos Cons. Min. Co., Sonora, Mexico. 1910, Mine contracting. 1910-12, Civil Engr., Daniels & Osmont, S. F., Calif. 1912-16, Engrg. Contr., Prop. Bradley Engrg. Co., Reno, Nev. 1916, Asst. Supt., Jacket, Crown Point Belches Min. Co., Gold Hill, Nev. 1916-17, Tech. Asst., H. I. Huston, Calif. 1917, Mill Supt., Nev. Packard Min. Co., Rochester, Nev. 1917-18, Mgr., Sassen Min. Co., Hayden Hill, Calif. 1918-19, Operating Supt., Natl. Met. & Chem. Co., Pittsburg, Calif. 1919, Mill Foreman, West End Min. Co., Tonopah, Nev.

**Edward George Broadbridge**, London, England.

Present position: Mgr., Compania Minera de la Coruna, Santiago, Spain.

Proposed by Edward T. McCarthy, W. S. Holloway, endorsed by Walter Broadbridge.

Born 1887, Brighton, England. 1896-1905, Brighton College. 1902-05, Germany. 1905-08, Camborne Sch. of Mines, C. S. M. 1908-11, Mine Sampler & Surveyor, Messrs. Bewick Mornings, Kalgoorlic, W. A. 1911-12, Surveyor, West Africa, Abantiakoon Mines. 1912-14, Minerals Separation Ltd. 1914-19, Min. wk. in France, Royal Engrs., as Capt.

**John Brunschwyler, Jr.**, Gallagher, W. Va.

Present position: Chief Engr., Paint Creek Coal Min. Co.

Proposed by J. M. Clark, C. E. Krebs, E. B. Snider.

Born 1887, Scranton, Pa. 1893-1901, St. Mary's Parochial Sch. 1901-03, Scranton Business College. 1903-06, Y.M.C.A. (night sch.). 1906-12, Inter. Corres. Sch. 1902-08, Chainman, Rodman, Draftsman & Transmitter for a Civil & Min. Engr. 1908-13, Asst. to Chief Engr. 1913-15, Resident Engr., Paint Creek Collieries Co. 1915, Mine Supt. 1915-17, Dist. Engr. on county roads. 1917-19, Chief Engr.

**Walter E. Buss**, Vincennes, Ind.

Present position—1915 to date: Min. Engr., Oliphant Johnson Coal Co.

Proposed by C. A. Herbert, Ralph D. Brown, Ralph E. Davis.

Born 1889, Fond du Lac Co., Wis. 1909-11, Wis. Min. Sch., Diploma. 1911-13, Draftsman & Instrumentman; 1914, Asst. Chief Engr., O'Gara Coal Co., Harrisburg, Ill. 1913-14, Min. Engr., Middle States Coal Corp., Terre Haute, Ind. 1914-15, Min. Engr., Wasson Coal Co., Harrisburg, Ill.

**Herbert Spencer Carpenter**, McRoberts, Letcher Co., Ky.

Present position: Supt. of Mines, 210 to 213, Cons. Coal Co.

Proposed by John H. Smyth, L. B. Abbott, Frank Haas.

Born 1883, Monroe, Orange Co., N. Y. 1895-99, Monroe High Sch. 1899-1900, Assoc. Business Inst., N. Y. 1903-06, Scientific Course, Cooper Inst., New York,

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS IV

N. Y. 1904-05, N. Y. Prep. Sch. 1902-06, Chief Clerk, Atlantic Ave. Improvement, Brooklyn, N. Y. 1906-09, Coal Miner, Min. Dept., D. L. & W. R. R., Inside Co., Scranton, Pa. 1909-12, Asst. Mgr., G. B. Markle Co., Jeddo, Pa. 1912-14, Mgr., coal mines, Thorne-Neale & Co., Minersville, Pa. 1914-18, Mgr., Way Div., Elk Horn Coal Corp., Wayland, Ky. 1918-19, Supt. Mines, Cons. Coal Co.

**Daniel Joseph Carroll, Orient, Ill.**

Present position—1914 to date: Asst. to Gen'l Supt., C. W. & F. Coal Co.

Proposed by George B. Harrington, Eugene McAuliffe, Carl Scholz.

Born 1887, Streator, Ill. 1907-08, Univ. of Ill. 1908-09, Transitman & Draftsman, Chicago & Milwaukee Elec. R. R., Highwood, Ill. 1909-10, Instrumentman & Inspector, H. L. Emerson, Chicago, Ill. 1910-12, Resident Engr., Rock Island Southern Ry. 1912-14, Min. Engr.; 1914 to date, Min. Engr. & Asst. to Gen'l Supt., C. W. & F. Coal Co.

**George Cyril Castle, Somerset, England.**

Present position: Chief Met. & Tech. Engr., Automatic & Electric Furnaces.

Proposed by S. N. Castle, Endorsed by Amer. Electrochemical Soc.

Born 1888, Newark-on-Trent, Nottinghamshire, England. 1898-1902, Mount Sch. 1902-06, Magnus College, degree of efficiency. Five yrs., Asst. Met., Worthington-Simpson Co.; 2 yrs., Asst. Met. & Chem., Hadfields Ltd., of Sheffield; 1 yr., Chief Met., J. Beardsaw & Co., Sheffield; 2 yrs., Chief Met., Petters, Ltd., England; 2 yrs., Cons., William Hassall & Co., Sheffield; 2 yrs., Cons. to All British Tool & Steel Co., Sheffield. 1918-19, Private time, Instr. in Met., Yeovil Tech. Inst.

**Newcomb Kinney Chaney, Lakewood, Ohio.**

Present position: Research Chem., National Carbon Co., Inc.

Proposed by Alexander L. Feild, George K. Burgess, Howard Scott.

Born 1883, Northfield, Minn. 1900-05, Carleton College. 1907-10, Oxford Univ. 1910-11, Univ. of Pa., B. S., M. S., M. A., Ph. D. 1911-12, Physical tests, photometry of arc lamps. 1913-17, Battery & elec. chem. research. 1917-18, Cons. Chem., Bureau of Mines, war gas investigations, Section Chief, Charcoal Unit, Amer. Univ. Exper. Sta. 1918-19, Cons. Chem., C. W. S., U. S. A., Research Div. 1919, Asst. Director, in charge research lab. of Natl. Carbon Co., Inc., Cleveland, Ohio.

**Lun Yuen Chow, Pinghsiang Colliery, Pinghsiang.**

Present position—1915 to date: Asst. Min. Engr.

Proposed by Y. F. Chen, William A. Wong, S. Ken Huang.

Born 1891, Ningpo, China. 1915, Lehigh Univ., E. M. 1915 to date, Asst. Min. Engr.

**Daniel Edgar Clune, Ft. Lauderdale, Fla.**

Present position—1918 to date: Field & Acting Supervising Engr., Const. Div., War Dept.

Proposed by W. S. Grether, H. Vincent Wallace, John M. Brooks.

Born 1879, Green Bay, Wis. Mo. School of Mines. 1907-09, Transitman, Steptoe Valley Smelt. & Min. Smelter, Nev. 1909-10, Transitman, Bridge Engr., Sp. de Mexico, Ry. Main Office, Tucson, Ariz. 1910-11, Mine & Mill Supt., Cerro Colo. Min. Co., Cerro Colo., Son., Mexico. 1911-14, Gen'l Mgr., Paradise Min. & Mill. Co., Paradise, Ariz. 1914-18, Private practice in gen'l enrg. wk., mine examination in Cuba & C. A. I.

**Eugene Lyon Colcord, Montcoal, Raleigh Co., W. Va.**

Present position: Engr., Colcord Coal Co., Montcoal, W. Va.

Proposed by J. Murray Clark, L. A. Gates, C. E. Krebs.

Born 1891, St. Albans, W. Va. 1907-10, W. Va. Univ. 1910-14, Instrumentman & Computer, Member Engrg. Dept., Rowland Land Co. 1914-16, Engr., Marsh Fork Coal Co. 1916-17, Asst. Engr., Colcord Coal Co. 1917-19, 1st Lieut. Engrs., U. S. A.

**Royssel John Cowan, Toledo, O.**

Present position—1910 to date: Chief Chem. & Met., National Malleable Castings Co.

Proposed by H. A. Schwartz, Enrique Touceda, J. S. Crowther, Jr.

Born 1885, Sharon, Pa. 1900-09, Asst. Chem., Sharon plant, National Malleable Castings Co.

**Paul R. Croll, Palmerton, Pa.**

Present position—1917 to date: Asst. Chief Research Div., N. J. Zinc Co.

Proposed by Frank G. Breyer, William H. Finkeldey, W. L. Maxon.

Born 1892, Schuylkill Haven, Pa. 1905-09, Lebanon High Sch. 1909-13, Univ. of Ill., B. S. 1913-15, Analytical Chem., Testing Dept. 1915-16, Research Investigator, Research Dept. 1916-17, Acting Asst., Chief Research Dept., N. J. Zinc Co.

**Harold Beukma Davis, Lancaster, N. Y.**

Present position: Unemployed.

Proposed by Chas. E. Locke, Carle R. Hayward, H. O. Hofman.

Born 1889, Lancaster, N. Y. 1908-12, Mass. Inst. Tech., S. B. 1912-13, Asst. Engr., Standard Steel Wks., Burnham, Pa. 1914-17, Asst. Supt., La Belle Kirkland Mines, Ltd. 1917-19, 1st Lieut., Air Service, U. S. A.

**Bronaugh Woodland Deringer, Spangler, Pa.**

Present position—1917 to date: Inspector of Mines, N. Y. C. R. R.

Proposed by James H. Allport, A. O. Sommerville, Rembrandt Peale.

Born 1889, Philipsburg, Pa. 1904, Philipsburg High Sch. Internatl. Corres. Sch., Scranton, Pa. 1906-10, Chainman, H. J. Hinterlectuer mine & land surveys. 1910, Transitman, Clearfield Bituminous Coal Corp'n. 1910-11, Transitman, H. J. Hinterlectuer bituminous mine surveys & mapping, Min. Engr., Charles E. Schlicher, in charge of mine surveys.

**Thomas DeVenny, Edgarton, W. Va.**

Present position—1917 to date: Supt., Freebuen Plant, The Portsmouth Solvay Coke Co.

Proposed by J. S. Shaw, L. E. Tierney, G. H. Wilcox.

Born 1889, Maybeury, W. Va. 1901-03, Princeton Academy. 1904, Old Point Comfort College. 1905-07, W. Va. Univ. 1910, Butte Sch. of Mines. 1908-09, Min. Engr., McDowell Coal & Coke Co., McDowell, W. Va. 1909-11, Private engr., Assoc. with B. W. Dyer, Butte, Mont. 1911-13, Mine Foreman; 1913-14, Mine Supt., Northwestern Improvement Co., Red Lodge, Mont. 1914-16, Chief Engr. & Supt. Construction for Turkey Gap Coal & Coke Co., Dott, W. Va. 1916-17, Supt., Turkey Gap Coal & Coke Co., Edgarton, W. Va.

**Clarence Dura Dolman, Chewelah, Wash.**

Present position—1917 to date: Chief Chem., Northwest Magnesite Co.

Proposed by R. B. Rogers, L. K. Armstrong, Francis A. Thomson.

Born 1886, Topeka, Kans. 1901-05, Topeka High Sch. 1905-09, Washburn College, Topeka, Kans., B. A. 1910-11, Asst. in A. T. & S. Fe, Test Dept. 1911-12, Chem., Otto Kuehne Preserving Co. 1912-15, Cement Chem., Washington Water Power Co.

**William Beaman Donoghue, La Fundicion, Peru.**

Present position: Furnace Foreman, Cerro de Pasco Copper Corp'n.

Proposed by T. W. Mather, Chester Atkinson, J. S. Newton.

Born 1886, Oxford Mills, Ont., Canada. 1908-12, Queens Univ., Kingston, Canada, B. S. 1912, Submitted paper to Canadian Min. Inst. 1912-14, Chem., Cerro de Pasco Min. Co., Peru. 1914-18, 2d Division, Canadian Engrs. 1918, Returned to Canada. 1919, Met. Bookkeeper, Cerro de Pasco Copper Corp'n.

**Thomas Francis Downing, Jr., Amherstdale, W. Va.**

Present position—1916 to date: Chief Engr., Amherst, Lundale, 3 Forks, Coal Companies & Amherst Fuel Co.

Proposed by James Archbald, James B. Neale, George M. Jones.

Born 1884, Cradley Heath, England. 1899-1901, Bloomsburgh State Normal Sch. 1901-03, Rodman, Lehigh Valley Coal Co., Hazelton Div. 1904, Rodman. 1904-05, Transitman. 1905-16, Dist. Transitman, Philadelphia & Reading Coal & Iron Co., Shamokin Div., Pa.

**Frank Aaron Edson, Norman, Okla.**

Present position: Field Geol., Okla. Geol. Survey.

Proposed by A. N. Winchell, Fred G. Rockwell, W. J. Mead.

Born 1879, Unadilla, N. Y. 1898, Duluth Public Sch. 1898-1900, Williams College. 1900-03, Univ. of Mich. 1909-10, Univ. of Wis., A. B. 1904-07, Drill helper. 1907, Chem., in Steel Corp'n. Laboratory, Coleraine, Minn. 1908, Sampler & Camp Clerk, U. S. Steel Corp'n. 1908, Dump Foreman, U. S. Steel Corp'n., Coleraine, Minn. 1911-18, Directing Explorations & Cons. Wk. 1918-19, Army, Y. M. C. A.

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**Lincoln Ehnborn**, Ironton, Colo.

Present position—1918 to date: Supt., Red Mountain Mines Co.

Proposed by George E. Collins, W. Rowland Cox, H. A. Guess.

Born 1884, New York, N. Y. 1903-05, 1915-17, Colorado School of Mines, E. M. 1905-06, Shoveler, Trammer, Timberman, Miner, various mines, Silverton, Colo. 1906-08, Engr., Silver Lake mines, Silverton, Colo. 1908-10, Supt., Iowa Gold Min. Co., Cons. Engr., Iowa-Tiger Leasing Co., Silverton, Colo. 1910-13, Mine Supt., Inde Gold Min. Co. 1913, Gen'l Mgr., Société des Mines de Matracal. 1913-14, Engr. Dept., Federal Lead Co., Flat River, Mo. 1917, Mine Foreman, Eden Gold Min. Co. 1918, Mine Supt., Mary Murphy Gold Min. Co., Ramley, Colo.

**Hal Edmund Ercanbrack**, Danville, Ill.

Present position—1911 to date: Wks. Engr., Hegeler Zinc Co.

Proposed by William F. Nawatny, Julius W. Hegeler, H. H. Stoek.

Born 1884, Elburn, Ill. 1904-09, Univ. of Ill., B. S. 1910-11, Asst. Engr., W. L. Fergus & Co., Chicago, Ill.

**Arno Carl Fieldner**, Pittsburgh, Pa.

Present position: Supervising Chem., Pittsburgh Experiment Sta., U. S. Bureau of Mines.

Proposed by D. J. Parker, E. A. Holbrook, J. W. Paul.

Born 1881, Vey, Ohio. 1900-01, Ohio Wesleyan Univ. 1903-06, Ohio State Univ., B. Sc. 1906, Industrial Fuel-Engr., Denver Gas & Elec. Co. 1907, Chem., Amer. Zinc & Chem. Co., Denver, Colo. 1907-09, Asst. Chem., U. S. Geol. Survey, Tech. Branch. 1909-13, Asst. Chem., U. S. Bureau of Mines, in charge Fuels Chem. Lab., Pittsburgh Exper. Sta. 1913-18, Chem., U. S. Bureau of Mines, in charge Fuels Chem. Lab., & in charge of gas-mask research at Pittsburgh and Amer. Univ. Exper. Sta., Washington, D. C. 1918-19, Chem., Chem. Warfare Service, U. S. A. (Major).

**Raleigh O. Fife**, Rodeo, N. Mex.

Present position—1913 to date: Mgr., Hilltop Metals Min. Co., Cochise County, Ariz.

Proposed by Louis D. Huntoon, Charles P. Berkey, G. S. Schmutz.

Born 1880, Humboldt, Kans. 1898-02, Univ. of Kansas. 1903-06, Mgr., Homestake Oil & Gas Co., Kansas. 1904-06, Mgr., Aurora Oil & Gas Co., Kansas. 1906-11, Mgr., Tabatacochi Min. Co., Sonora, Mexico.

**James Henry Finger**, Salida, Colo.

Present position—1918 to date: Chief Chem., Ohio & Colo. Smelt. & Refin. Co., Colo.

Proposed by A. T. Thomson, D. F. Haley, E. J. Bruderlin.

Born 1884, Girard, Kans. 1902-06, Colo. College, B. S. 1906-08, Mill Chem., Asst. Chem., Assayer, U. S. Zinc Co., Pueblo, Colo. 1908-11, Chief Chem., U. S. Zinc Co. 1911-18, Chem., Ohio & Colo. Smelt. & Refin. Co., Colo.

**Frederick William Foote**, New York, N. Y.

Present position: Cons. Min. Engr.

Proposed by Albert C. Burrage, W. R. Ingalls, Harry J. Wolf.

Born 1892, New York, N. Y. 1909-12, Columbia Univ. 1913-14, Colo. Sch. of Mines, E. M. 1914, Britannia Min. & Smelt. Co., Britannia Beach, B. C., Canada. 1915-16, Civil Engr., E. I. du Pont de Nemours & Co., City Pt., Virginia & Carneys Pt., N. J. 1916-17, Editorial Asst., *Engrg. & Min. Jnl.* 1917, Lord Geoffrey Ores Co., Visen, Portugal. 1917-18, Asst. Engr., George Warren Tower, Jr. 1918-19, U. S. N. Bureau of Ordn.

**Harry Allen Frame**, Cleveland, Okla.

Present position—1916 to date: Mgr. & Chief Engr., National Products Co., Pittsburgh, Pa.

Proposed by Charles E. Locke, Carle R. Hayward, H. O. Hofman.

Born 1881, Shubenacadie, N. S., Canada. 1900-02, Dalhousie College. 1903-07, Mass. Inst. Tech., S. B. 1907-09, Apprentice, Pennsylvania Steel Co., Steelton, Pa. 1909-13, Engr., Lake Superior Corpn., Sault Ste. Marie, Ont. 1913-16, Supt., National Products Co.

**Adam George Frank, Lansford, Pa.**

Present position—1913 to date: Mech. Engr., Lehigh Coal & Navigation Co.

Proposed by R. E. Hobart, W. G. Whildin, F. B. Nold.

Born 1885, Hazelton, Pa. 1903, Hazelton High Sch., International Corres. Sch. 1903-06, Rodman on Min. Engrg. Corps., Lehigh Valley Coal Co., Hazelton, Pa. 1906-09, Tracer, Mech. Draftsman & Estimator on pumping mach., Jeansville Iron Wks., Hazelton, Pa. 1909-10, Mech. Draftsman, Ohio River Project, United States Engrs., Wheeling, W. Va. 1910, Mech. Draftsman in Min. Mach., Tenn. Coal, Iron & R. R. Co., Birmingham, Ala. 1910-11, Mech. Draftsman on Min. Mach., Fairmont Min. Mach. Co., Fairmont, W. Va. 1911-13, Mech. Draftsman on anthracite breaker & min. equipment, Del. & Hudson Co., Scranton, Pa.

**Walter Herbert Fulweiler, Wallingford, Pa.**

Present position—1913 to date: Chief Chem., United Gas Improvement Co., Philadelphia, Pa.

Proposed by I. N. Knapp, William E. Saunders, Walton Clark.

Born 1880, Philadelphia, Pa. 1897-1901, Univ. Pa., B. S. 1901-02, Chem., Philadelphia Gas Wks., Philadelphia, Pa. 1902-03, Cadet Engr. 1903-04, Supt. of Manufacture, Kansas City Missouri Gas Co. 1904-06, Business for self in N. Mex. 1906-07, Inspector of Machinery, Sta. B., Philadelphia Gas Wks. 1907-13, Research Dept., United Gas Improv. Co.

**Jean Paul Gerlough, Cake, Ore.**

Present position: Foreman, Rainbow Mill.

Proposed by Francis Jenkins, J. E. Alley, J. W. Gwinn.

Born 1891, Vancouver, Wash. 1898-1906, Public Schools, Boise, Ida. 1907-11, Boise High School. 1912-16, Univ. of Idaho, B. A. 1906-07, General office work, U. S. G. S.—R. S. Headquarters, Boise, Ida. 1908, summer, Logging, Bagdad Chase Min. Co., Atlanta, Ida. 1909, summer, Millman, Bagdad Chase Min. Co. 1910, summer, Millman, Greyhound Min. Co., Boise, Ida. 1911-12, Millman, George F. Roth Co., Homestake Mine, Neal, Ida. 1913, Trammer, Mucker, General Millman, Hoist Engr.; 1914, Pumpman, Assay Helper, Filterman & Solution Man; 1916-18, Shift Foreman, Rainbow Mill, Cake, Oregon. 1918-19, Lieut., U. S. Army.

**Frank Good, Carbonado, Wash.**

Present position—1918 to date: Mgr., Carbon Hill Coal Co.

Proposed by John N. Pott, S. H. Ash, B. B. Neiding.

Born 1872, Danville, Pa. High School, Hazelton, Pa. 1890-92, Chairman, G. B. Markle & Co., Jeddo, Pa. 1892-94, Coal Inspector, L. V. C. Co., Hazelton, Pa. 1894-1900, Chairman & Transitman, A. S. Van Wickle Coal Co., Hazelton, Pa. 1900-03, Asst. Engr., R. & P. Coal & Iron Co., Punxsutawney, Pa. 1903-07, Div. Engr., D. L. & W. Coal Co., Scranton, Pa. 1907-10, Res. Engr., N. W. I. Co., Roslyn, Wash. 1910-12, Supt., Rose Marshall Coal Co., Cumberland, Wash. 1912-13, Mine Inspector, N. W. I. Co., Roslyn, Wash. 1913-14, Engr., Carbon Hill Coal Co., Carbonado, Wash. 1914-18, Supt., Carbon Hill Coal Co.

**Dugald Gordon, Fort Worth, Tex.**

Present position: Geol., Sinclair Gulf Oil Co.

Proposed by Jon A. Udden, E. E. Enis, Robert Hamilton.

Born 1886, Rose Center, Mich. 1905-06, Milliken Univ., Ill. 1906-09, Univ. of Michigan. 1909-19, Asst. Geol., Tennessee Coal & R. R. Co., Birmingham, Ala.

**James Preston Hart, Tonopah, Nev.**

Present position—1918 to date: Min. Engr., Tonopah Extension Min. Co.

Proposed by John L. Dynan, John G. Kirchen, Jay A. Carpenter.

Born 1882, Reno, Nev. 1903-07, Nev. State Univ., B. S. & E. M. 1907, Hard rock min., Sierra Mazuma Leasing Co. 1907-08, Mineral land surveying & eng. wk., Rawhide & Reno. 1908-09, Min. & mill., Chafey, Nev. 1909-10, Assaying, sampling, surveying, Bullfrog-Pioneer L. & M. Co. 1910-11, Shift Boss, Nev. Goldfield Reduction Co. 1911-13, Foreman, West End Mill, Tonopah. 1913, Supt., Manhattan Mill. & Ore Co. 1913-15, Foreman, West End Mill, Tonopah. 1915-17, Mill Supt. & Engr., Rattlesnake Jack Min. Co. 1917-18, Supt., Mill Constr., Silver Mines Corp.

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**Samuel Vinton Haworth**, Huntington, W. Va.

Present position: Engr., Main office, Elkhorn Piney Coal Min. Co.

Proposed by W. H. Cunningham, James S. Cunningham, G. S. Borden.

Born 1886, Ravenswood, W. Va. 1900-01, Huntington Public & High Sch. 1901-04, Marshall College. 1904-08, W. Va. Univ. 1904-08, summer, Rodman, U. S. Coal & Oil Co., Holden, W. Va. 1908-09, Instrumentman, Guyan Oil Co., Huntington, W. Va. 1910-11, Instrumentman, C. & O. Ry., Levisa Fork Ry. 1911-12, Masonry Inspector, Asst. Res. Engr., S. V. & E. Ry. 1912-13, Various engr. offices in Huntington, W. Va. 1913-17, Div. Engr., Weeksbury, Ky. Plt.; 1917-19, Div. Engr., Stanaford, W. Va. Plt., Elkhorn Piney Coal Min. Co.

**Henry Sager Hazlitt**, Dixie, Ida.

Present position: Co-owner Olivia Group of Min. Claims.

Proposed by J. McD. Porter, Rowland King, L. K. Armstrong.

Born 1856, Henley, Calif. Common Sch. of Calif. 1893-19, Min., Dixie Min. Dist., Idaho; prospecting, Nevada Dist. 1908-10, Cons. Engr., Majestic Gold & Silver Min. Co., Ariz.

**Charles W. Hier**, East Pittsburgh, Pa.

Present position—1916 to date: Research Chem., Westinghouse Elec. & Mfg. Co.

Proposed by A. N. Winchell, Paul D. Merica, Jesse L. Jones.

Born 1884, Clarion, Ia. 1905, Univ. of Minn. 1907-10, Univ. of Wis., A. B., M. A., Ph. D. 1910-13, Asst. Director, Research Lab., National Carbon Co., Cleveland, O. 1913-15, Member, Cleveland Research Lab. 1915-16, Asst. Prof. Chem., Syracuse Univ.

**Fanny R. M. Hitchcock**, Philadelphia, Pa.

Present position: as below.

Endorsed by American Society for the Advancement of Science and American Electrochemical Society.

Born 1851, Brooklyn, N. Y. Private schools. 1890-94, Univ. of Pa., Ph. D. 25 yrs., research wk., own lab. Specialized in chem. of radioactive elements & met. of iron & steel.

**John D. Hoff**, Oakland, Calif.

Present position: Pres., Hoff Magnesite Co., Inc.

Proposed by Fletcher Hamilton, H. W. Turner, endorsed by Amer. Electrochem. Soc.

Born 1858, Miamisburg, O. 1876, Geol. & Chem., Caldwell's College, Rome, Ga. 1876-83, Discovered, mined, milled manganese deposits, Cave Spring, Ga. 1883-84, Discovered and worked, High Bench Gold Gravel, Murray, Ida. 1884-87, Discovered fire-clay beds, Elsinore, Cal. Built fire-brick and sewer-pipe plant and proved the value of the clays. 1880-1919, Asbestos mfg. business, oil and magnesite business.

**Axel Gustaf Emanuel Huttgren**, New York, N. Y.

Present position—1915 to date: Chief Engr., Research of Aktiebolaget Svenska Kullagerfabriken, Gotenburg, Sweden.

Proposed by K. F. Goransson, B. H. De Long, George F. Comstock.

Born 1886, Kalmar, Sweden. 1903-08, Tech. Univ. of Stockholm, Sweden. 1913-14, Tech. Univ. of Charlottenburg, Germany, Met. E. 1911-14, Head of Mech. Testing & Met. Dept.; Associate at the Institute for Testing Materials of The Technical Univ. of Stockholm, Sweden.

**Gaylord Clark Jaynes**, Bessemer, Ala.

Present position—1918 to date: Min. Engr., Gulf States Steel Co.

Proposed by L. E. Geohegan, C. A. Moffett, W. J. Penhallegon.

Born 1883, Delaware, Ohio. 1902-06, Ohio State Univ., E. M. 1904, summer, Miner; 1905, summer, Sampler, Smelter, Cananea, Mex. 1906, Min. Engr., Burro Mt. Copper Co., N. M. 1907, Min. Engr., Patagonia Min. Co., Patagonia, Ariz. 1908-09, U. S. Deputy Mineral Surveyor, Tucson, Ariz. 1910, Supt., Hartman mine, Slano, Mex. 1911-13, Cons. Min. Engr., H. L. Hollis, Chicago, Ill. 1914, Cons. Min. Engr., Mr. Rush, Terre Haute, Ind. 1915, Min. Engr., Y. S. O. Coal Co., Barton, Ohio. 1916, Constr. Engr., Goodyear Tire & Rubber Co., Akron, Ohio. 1917, Asst. Engr., C. D. Putnam, Dayton, Ohio.

**John W. Johns**, Marysville, Mont.

Present position—1915 to date: Supt., Shannon & Gloster Mines, Barnes King Devel. Co.

Proposed by Horace V. Winchell, Samuel Barker, Jr., Reno H. Sales.

Born 1882, Wales. 1902-06, Mont. State School of Mines, E. M. 1900-09, Chairman & Engr., Barker & Wilson Co., Butte, Mont. 1909-10, Engr., Corbin Copper Co. 1910-13, Supt., Blue Bird Gold, Silver & Copper Co., Wickes, Mont. 1913-15, Miner, Shift Boss, Leonard mine, A. C. M. Co., Butte, Mont.

**Shih Ching Kang**, Ki, China.

Present position—1916 to date: Asst. Min. Engr., Pinghsiang Colliery, China.

Proposed by Y. F. Chen, William A. Wong, S. Ken Huang.

Born 1889, Kiang Su, China. 1915, Birmingham Univ., England, Diploma of Mining. 1910, Graduated in Civil Engineering course, Government Inst. of Tech. (formerly Nan Yang College, China). 1910-11, Lecturer on mathematics. 1916, Asst. Min. Engr., Pinghsiang Colliery.

**Frank James Katz**, Washington, D. C.

Present position: Expert-special Agent, U. S. Bureau of the Census & Geol., U. S. Geol. Survey.

Proposed by Edson S. Baston, George Otis Smith, David White.

Born 1883, New York, N. Y. 1901-06, Univ. Wis. 1906-07, Univ. Chicago, B. A. 1904, Compassman & Geol., exploration party in Ont. 1905, Geol. Field Asst., U. S. G. S. 1906, Geol. on exploration wk. in Ont. 1907-19, Geol. Aid, Junior Geol., Assoc. Geol. & Geol., U. S. G. S. 1919, In charge Div. of Mines & Quarries of the 145th Decennial Census.

**Ngo Yue Alexander King**, Pinghsiang Collieries, Ki, China.

Present position—1917 to date: Engr.-in-chief, Pinghsiang Colliery, China.

Proposed by Y. F. Chen, William A. Wong, S. Ken Huang.

Born 1881, Changsha, China. 1915, Grad., Tech. Hochschule, Aachen, Germany. 1904-05, Lecturer on chem., Nan Yang College, Shanghai. 1905-06, Lecturer on chem. & physics, Yin-chu school, Changsha, China. 1907-09, Instructor, St. Johns Univ., Shanghai, China. 1916-17, Asst. Min. Engr., Pinghsiang Colliery.

**Norman Victor Sydney Knibbs**, London, England.

Present position: Chief Chem., Denny Chemical Engrg. Co.

Proposed by Harry S. Denny, George Denny, Francis Drake.

Born 1894, Sydney, Australia. 1911-15, Univ. of Melbourne, Australia, B. Sc. 1914-15, Demonstrator in chem., Melbourne Univ. 1915-19, Chem. Dept., Explosives Supplies, Univ. of Munitions of War, England.

**Ansel Leon Knouse**, Seattle, Wash.

Present position—1913 to date: Gen'l Mgr., Beacon Coal Mines Co.

Proposed by Percy E. Wright, I. N. Dally, Glenville H. Collins.

Born 1879, Sterling, Kans. 1905-06, Berry Bros., Fairbanks, Alaska. 1906-13, Not engaged in mining.

**Hans H. Kudlich**, Scranton, Pa.

Present position: Special Engr., Hudson Coal Co.

Proposed by Wilbur L. Cross, Jr., J. M. Humphrey, George T. Haldeman.

Born 1888, Drifton, Pa. 1907-11, Lafayette College, E. M. 1912-17, Min. Engr. & Asst. Supt., Wilkes-Barre Anthracite Coal Co., Wilkes-Barre, Pa. 1917-19, Min. Engr., charge of all engrg. work, Pennsylvania Coal Co., Franklin, Pa.

**Bertrand J. Latimer**, El Paso, Tex.

Present position—1916 to date: Engr. & Asst. Supt., Southwestern Portland Cement Co., also Acting Supt., Darbyshire-Harvie Iron & Machine Co.

Proposed by Frank J. Nagel, William J. Quigley, A. L. Eaton.

Born 1880, Grinnell, Iowa. 1904, Iowa State College. 1905-10, Colo. School of Mines, E. M. 1910-11, Asst. to Supt., Assayer & Engr. with small min. Co. near Victoria, Tamaulipas, Mex. 1911-12, Mine Surveyor & Topographical Surveyor, Sombrerete Min. Co., Sombrerete, Zacacetas, Mex. 1912, Mine Surveyor, Buena Tierra Min. Co., Sta. Eulalia, Chih., Mex. 1912-13, Mine Surveyor, Designing Engr. & Asst. to Mgr. & Supt., Concheno Min. Co., Concheno, Chih., Mex. 1913-14, Power-plant designing, Southwestern Portland Cement Co., El Paso, Tex. 1914-16, Own employ as min. engr., buyer & seller of machinery, ores & metals.

**Nils David Levin**, Columbus, Ohio.

Present position—1908 to date: Chief Engr., Min. Dept., Jeffrey Mfg. Co.

Proposed by S. B. Belden, E. N. Zern, W. E. Fohl.

Born 1867, Sweden. Örebro Tech. Sch. 1889–1908, Charge of designing, Goodman Mfg. Co., Chicago, Ill.

**Charles Farrington Lewis**, Greenfield, Mass.

Present position: Met. Engr., Greenfield Tap & Die Corp.

Proposed by Leslie D. Hawkridge, Albert Sauveur, Herbert M. Boylston.

Born 1889, Gloucester, Mass. 1904–08, De Merritte School, 1908–12, Harvard College, S. B. 1912, Chem., American Steel & Wire Co., Worcester, Mass. 1912–17, Met., Wyman-Gordon Co., Worcester, Mass. 1917, Met. Engr., American Incandescent Heat Co. 1917–18, Captain, U. S. Ordnance Dept.

**Joseph Robert Linney**, Lyon Mountain, N. Y.

Present position: Mgr., Chateaugay Ore & Iron Co.

Proposed by R. H. Buchanan, R. Y. Williams, Charles Dorrance.

Born 1888, Rendham, Pa. 1893–97, Public Sch., Intern'tl Corres. Sch., Y.M.C.A. 1912–14, Asst. Inside Foreman; 1914–16, Mine Foreman; 1916–19, Colliery Supt., Hudson Coal Co.

**Cheng-Chang Lu**, Changsha, China.

Present position—1916 to date: Mgr., Youseng Manganese Min. Co.

Proposed by Y. F. Chen, S. Ken Huang, William A. Wong.

Born 1886, Shanghai, China. 1904, Nanking Univ. 1906, Tokio High Technical School. 1908–11, Sheffield Univ., M. E. 1911–12, Chief of Foreign Dept., Ningko Revolutionary Government. 1912, Chief of Blast Furnace Dept., Hanyang Wks. 1912–14, Chief of Steel Wks. Dept. 1914–15, Acting Supt., Hanyang Iron & Steel Wks. 1916–17, Chief of Technical Dept., Hunan Min. Bureau, China.

**William Meek McKee**, Pittsburgh, Pa.

Present position: Mgr., Pittsburgh Branch, Jeffery Mfg. Co.

Proposed by Sanford B. Belden, Patrick G. Graney, S. A. Scott.

Born 1877, Chillicothe, Ohio. 1895–99, Univ. of Mich., B. S., E. E. 1899–01, Constr. wk., Paris Exposition and Manchester, England. 1901–04, Mine Elec., Pittsburgh Coal Co. 1904–07, Engrg. Dept.; 1907–09, Mgr., St. Louis Branch; 1909–11, Mgr., Chicago Office, Jeffery Mfg. Co. 1911–12, Supt. of Mines, Montgomery County Coal Co., Hillsboro, Ill. 1912–14, Field work on coal property. 1914–17, Pittsburgh Branch, Jeffery Mfg. Co. 1917–19, Major, Engr. Corps, U. S. A.

**Errol Mac Boyle**, San Francisco, Calif.

Present position: Cons. Engr. & director, Idaho-Maryland Mines Co. of Grass Valley.

Proposed by Roy H. Elliott, Wilbur H. Grant, Edwin Higgins.

Born 1880, Oakland, Calif. 1899–1903, Univ. Calif. 1906–07, Columbia Univ., B. S. 1903–06, Surveyor & Engr., North Star Mines Co. 1906, Asst. Supt., Gaston Min. Co. 1907–08, Mgr. Bldg. Dept., Spring Valley Water Co. 1909, Opened cons. eng. office with Gelasio Caetani, Crocker Bldg., San Francisco. 1910, Examination of mineral deposits, Philippines, for F. W. Bradley & M. L. Requa. 1911, Engr. for F. W. Bradley. 1912, Mine examinations, Albert Burch & W. J. Toring. 1913–15, Field geol., Calif. State Min. Bureau. 1916–19, Vice-Pres. & Mgr., Director, Union Hill Mines & Gold Point Cons. Mines.

**George James MacKay**, Kingston, Ont., Canada.

Present position—1918 to date: Prof. of Met., Queens Univ.

Proposed by Stanley N. Graham, C. W. Drury, Alfred W. V. G. Wilson.

Born 1873, Bruce Co., Ont., Canada. 1903–07, Queens Univ., B. Sc. 1907–10, In charge research lab. & Asst. in Min. & Met., Queens Univ. 1910–13, Asst. to Cons. Met., East Rand Prop. Mines, Johannesburg, S. Africa. 1913, Met., Machavie Gold Mines, Ltd., Pochefstroom, S. Africa. 1914–16, Tech. Sec'y, Dept. of Mines, Ottawa, Canada.

**William John Merten**, Mansfield, Ohio.

Present position: Asst. Mfg. Supt., Ohio Brass Co.

Proposed by W. H. Argue, F. L. Wolf, W. M. Corse.

Born 1876, Essen, Germany. 1892–96, Tech. School, Essen, Germany. 1907–12, Carnegie Inst. of Tech., B. S. & M. E. 1907–12, Inspector; 1912–16, Met. & Chief Chem., Union Switch & Signal Co., Swinvale, Pa. 1916–18, Met. Engr., charge of labs., Firestone Steel Products Co., Akron, Ohio. 1918–19, Met. Engr., Twain City Forge & Fdry. Co., Stillwater, Minn.

**Vernon Freeman Marsters**, Kansas City, Mo.

Present position: Cons. Geol. Engr.

Proposed by R. S. Hazeltine, J. C. Branner, Charles P. Berkey.

Born 1867, Kings Co., Nova Scotia, Acadia Univ., Wolfville, N. S. Student, Instructor, Cornell Univ. Harvard Univ., A. B. & A. M. 1889-91, Instr. Cornell Univ. 1891-1903, Prof. of Geol., Ind. Univ. 1905-08, Chief Geol., Div. of the Cuerpo de Ingenieros de Mines del Peru, S. A. 1908-11, Cons. Geol., Peru, S. A. 1911-17, Cons. Geol. to N. Y. & Honduras Rosario Min. Co., San Juancito, Honduras, C. A. 1917 to date, Cons. Geol. Engr., Kansas City, Mo.

**Robert Stanley Merriam**, Climax, Colo.

Present position: Asst. Supt., Climax Molybdenum Co., Climax, Colo.

Proposed by S. Power Warren, D. F. Haley, H. L. Brown.

Born 1878, New Brunswick, Canada. 1905, Mo. School of Mines, E. M. 1905-18, Member of firm, Merriam & Merriam, Min. Engrs., Wallace, Idaho. 1918 to date, Engr., Climax Molybdenum Co.

**Giacomo Merizzi**, Milan, Italy.

Present position: Mgr. & Member of Board of Tecnonasio Ital. Brown Boveri.

Endorsed by Amer. Inst. of Electrical Engrs., Amer. Electrochemical Society.

Born 1866, Sondrio, Italy. Turin Politechnical High Sch., Eng. 1902 to date, Mgr. & Member of Board of Tecnonasio Italiano Brown Boveri, Milan.

**Wendell Z. Miller**, Tulsa, Okla.

Present position—1917 to date: Geol., Gypsy Oil Co.

Proposed by George C. Matson, James H. Gardner, Stanley C. Herold.

Born 1892, Gallipolis, Ohio. 1912, Ohio Wesleyan Univ. 1913-14, Univ. of Chicago. 1915, Fellow, Univ. of Chicago, A. B. 1912, Field wk. in Wis. & Colo. 1913, Asst. Geol., Ohio Geological Survey. 1914, Geol., Petroleum Expl., in Canada, Canadian Pacific R. R. 1915, Geol., Roma Oil Co., Okla., Kansas & Texas. 1916-19, Geol., Gypsy Oil Co., Expl. in S. A.

**Paul B. Moore**, Magdalena, N. Mex.

Present position: City Engr., Magdalena, N. M., & Cons. Wk.

Proposed by G. O. Brooks, Cony T. Brown, P. H. Argall.

Born 1885, Boston, Mass. Grammar & High Sch., Newton, Mass. Bryant & Stratton Sch., Boston, Mass. 1905-09, Min. wk., Foreman, Surveyor, office, assaying, & gen'l underground & surface wk., Gold River Mines & Power Co., Lincoln mine, Chester Basin, N. M. Micmac Gold Min. Co., Bridgewater, N. S., Chambers-Ferland mine, Cobalt, Ont., MacAdoo Tunnel, Jersey City, N. J. 1909-10, Asst. Engr., Cambridge Subway, Boston El. Ry. Co. 1911-13, Cons. wk., Cons. Engr., La Luz Min. Co., mine examinations, reports, Swastika Min. Co., Great Bear Mine Co., Albuquerque, N. M. 1913-14, Cons. wk., mine examinations, etc. 1914-17, Supt., Black Cloud Min. & Mill. Co., Magdalena, N. M. 1917-18, Highway Supt., & Dist. Engr., Highway Location, N. Mex., State Highway Commis. 1918, First Lieut., U. S. A. 1919, Cons. wk., Mine & Oil Survey.

**Joseph Nelson Nevius**, Pasadena, Calif.

Present position: Independent; Mgr., Octave Mines Co.; Representative Arkansas Zinc & Smelt. Corpn.; Western Engr., L. Vogelstein & Co.

Proposed by Frank W. Royer, Alvin B. Carpenter, James W. Neill.

Born 1873, West Orange, N. J. 1888-90, High School. 1890-94, Cornell Univ. 1894-99, Asst. Geol., N. Y. State Univ. 1899-1900, Geol., Nichols Copper Co., San José, Tamaulipas, Mexico. 1900-04, Engr., Compania Metalurgica Mexicana, Montezuma Lead Co., Santa Barbara, Chih. 1904-07, Independent; Headquarters, Hermosillo, Sonora. 1907-19, Independent; Headquarters, Pasadena, Calif. Chief Clients, L. Vogelstein & Co., El Arco Mines Co., Arkansas Zinc & Smelt. Corpn., Mgr., Octave Mines Co., Octave, Ariz.

**Leonard Victor Newton**, Chicago, Ill.

Present position: Engr. & Supt. of Eqpt.

Proposed by S. W. Parr, E. A. Holbrook, H. H. Stoeck.

Born 1891, Chicago, Ill. 1898-1905, Ravenswood Sch. 1905-09, Lake View High Sch. 1909-13, Ill. Univ., B. S. 1913-17, Supt. of Shops, Chicago Telephone Co. 1917, Gen'l engr. wks., The Texas Co.

# AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS lxiii

**John Ogden, Philadelphia, Pa.**

Present position—1912 to date: Mgr., Ogden Laboratories.

Proposed by William B. Shaffer, H. C. Parmelee, N. S. Keith.

Born 1862, Salem, N. J. High Sch. 1879–83, Philadelphia College of Pharmacy, Ph. G. 1897–12, Mgr., Ogden Assay Co., Denver, Colo.

**John Johnston O'Neill, Ottawa, Ont., Canada.**

Present position: Geol. on the Geol. Survey of Canada.

Proposed by A. N. Winchell, W. J. Mead, W. C. Hotchkiss.

Born 1886, Port Colborne, Ont., Canada. 1905–10, McGill Univ. 1910–12, Yale University. 1912–13, Univ. of Wis., B. Sc., M. Sc., Ph. D. 1909–10, summer, Asst. Geol. Survey of Canada field parties. 1911–12, Report on Monteregian Hills, Beloeil and Rougemont, Que., *Memoir* 43, Geol. Survey of Canada. 1912–13, Geol. wk., Onaping Dist., Ont. 1913–16, Geol., Canadian Arctic Exped. 1917–18, Investigation, economic geol., Hazelton Dist., *Memoir* 110, B. C., Canada. 1918–19, Investigation of platinum, Canada. 1919, Investigation, economic geology, Salmon River Dist., B. C.

**Robert Tressel Paessler, Wilkes-Barre, Pa.**

Present position: Mgr., Paessler, Heller & Jacoby, Inc.

Proposed by Albert Sauveur, Herbert M. Boylston, endorsed by Amer. Chem. Soc.

Born 1890, Van Wert, Ohio. 1908–12, Harvard Univ., A. B. 1912–13, Own chem. lab., Wilkes-Barre, Pa. 1913–14, Partnership with T. R. Heller, as Mgr. 1914–19, Lab. incorporated in Pa. Charter. 1913–14, Chem., Wilkes-Barre Dept. of Streets, Pa. 1914–15, Chem., Luzerne County Road & Bridge Dept., Pa. 1916–19, Chem., Internat. Fabricating Corp., Forty Fort, Pa. 1917–18, Chem., Luzerne County Food Administration. 1917–18, Chem., Luzerne County Fuel Administration.

**Walter Huntington Parker, Minneapolis, Minn.**

Present position: Assoc. Prof. of Min., Univ. of Minn.

Proposed by W. R. Appleby, Peter Christianson, Elting H. Comstock.

Born 1884, Stillwater, Minn. 1903–07, Sch. of Mines, Univ. of Minn., E. M. 1908–12, Min. Engr., International Coal Co. & Montana Coal & Iron Co. (jointly), Bearcreek, Mont. 1912–13, Cont. & Bldg. Constr., Minneapolis, Minn. 1913–14, Canadian Investment Co., Vancouver, B. C., Canada. 1914–16, Cons. wk., examining properties, Canada, Minn. & Mont. 1916–17, Structural Engineer, American Beet Sugar Co., Rocky Ford, Colo. 1917, R. O. T. C., Presidio of San Francisco; C. A. T. C., Fort Scott, Calif. 1917–19, Captain, Coast Artillery Corps, U. S. A.

**Greenleaf Whittier Pickard, Newton Centre, Mass.**

Present position—1906 to date: Cons. Engr., Wireless Specialty Apparatus Co., Boston.

Proposed by Henry S. Kimball, F. S. MacGregor, Henry A. Wentworth.

Born 1877, Portland, Me. 1895–96, Lawrence Scientific Sch. 1897, Mass. Inst. of Tech. 1900–01, Research Engr. & Chem., Amer. Min. & Metal Extraction Co., Boston, Mass. 1901–02, Research Engr., Amer. Wireless Telephone & Telegraph Co., Boston, Mass. 1902–06, Engr., Amer. Tel. & Teleg. Co. 1906–19, Cons. Engr., Vice-pres., & Tech. Director, Wireless Spec. Apparatus Co.

**Eugen Paul Polushkin, New York, N. Y.**

Present position—1918 to date: Met. of Standard Chem. Co.

Proposed by Ignace Schilowsky, Theodor Smirnof, E. Blough.

Born 1880, Russia. 1899, Gymnasium, Kostroma, Russia. Min. Inst. in Petrograd, Russia. 1913–15, Met. in experimental lab., Inst. of Ways, Petrograd, Russia & Instr. of Min. Inst., Petrograd, Russia. 1915–17, Chief Inspector, Russian Artillery Commission. 1917–18, Chief Inspector, Russian Mission on Ways of Communication. 1918–19, Met. Standard Chem. Co.

**Frank Ethelwulf Powers, Pottsville, Pa.**

Present position: Treas., Ajax Contract. Co.

Proposed by James Archbald, Jr., E. C. Luther, J. Parke Hood.

Born 1887, Pottsville, Pa. 1904–08, Univ. of Pa., B. S. 1908–11, Civil Engrg. Dept.; 1911–16, Asst. Supt., Open Hearth Dept., Eastern Steel Co., Pottsville, Pa. 1916–19, Sgt., Lieut., Capt., U. S. A. Engr. Corp.

**Wilford L. Riser, Homestead, Ore.**

Present position—1916 to date: Mill Supt., Homestead Iron Dyke Mines Co.

Proposed by J. R. Buchanan, Thomas H. Leggett, Edwin Ludlow.

Born 1889, Salt Lake City, Utah. 1908-10, Univ. of Utah. 1910, Chilian Mill Operator; 1911, Classifier Operator; 1912-13, Classifier Operator & Classifier Foreman; 1914, Met. Dept., Flotation Experiments; 1915, Met. Dept., Mill Foreman; 1916, Met. Dept., traveling repr. Utah Copper Co.

**Fred Rush, Terre Haute, Ind.**

Present position: Civil & Min. Engr.

Proposed by H. M. Chance, Willard J. Reintjes, G. S. Patterson.

Born 1858, Clinton, Ind. Public Schools of Ind. & Lebanon, Ohio. 1881-94, Deputy Co. Surveyor, Vermillion Co., Ind. 1894-1903, Gen'l engrg. wk., G. S. Patterson, Vivian, W. Va. 1903-11, Gen'l engr. practice. 1911 to date, in partnership with A. C. Everson, mine constr. surveying, etc.

**Shuji Sato, Chosen, Japan.**

Present position—1917 to date: Prof. of Min., Kejyo Tech. College & Min. Engr., Min. Bureau Govt.

Proposed by Iwaki Kikkawa, Shigetaro Kawasaki, Bonzo Katsura.

Born 1888, Yamagata, Japan. 1906-09, Second High Sch., Sendai, Japan. 1909-12, Tokyo Imperial Univ. 1912-14, Asst. Engr., Govt. coal mine, Hejyo, Chosen, Japan. 1914-17, Asst. Engr., Min. Bureau Govt. Gen'l, Chosen.

**Joseph Hassitt Saville, Wilmington, Del.**

Present position—1917 to date: Asst. Mgr., Pyrites Co., Ltd.

Proposed by Louis V. Bender, Frederick Laist, H. W. Aldrich.

Born 1889, Saratoga, Wyo. 1904-10, S. D. State School of Mines, B. S. & E. M. 1906-10, summers, Underground wk. in gold mills, Black Hills of S. D. 1910-11, Assayer, & Mill Foreman, Clara Belle mine. 1911-12, Mine examination, mill design & Supt., Forest City Min. & Mill. Co., Hill City, S. D. 1912-17, 1 yr. 6 mo., Testing Dept.; 1 yr., Chem. wks.; 2 yrs. 6 mo., Experimental leaching & Gen'l Foreman & Supt., Washoe Smelter, Anaconda Copper Min. Co.

**Christian Francis Schilling, Ray, Ariz.**

Present position: Mine Operator.

Proposed by L. S. Cates, D. C. Jackling, W. S. Boyd.

Born 1863, New York, N. Y. 1897, Operated min. claims, Ray Central Min. Co. 1897-1916, Owned & operated claims, Ray Broken Hill Min. Co., Ray, Ariz. 1916-18, Pres., Ray Broken Hill Min. Co.

**Jiuro Shimono, Ashio, Japan.**

Present position—1918 to date: Gen'l Supt. of Mills, Ashio Copper Co.

Proposed by Kazuye Kibe, Atsumaru Sakaguchi, I. Kitsunozaki.

Born 1887, Gifu, Japan. 1907-11, Second High School. 1911-13, Kyoto Imperial Univ., degree of Kogakushi. 1913-16, Engr., underground; 1916-17, Supt. of Kotaki mill; 1917-18, Supt. of Tsudo mill, Ashio Copper Mines.

**Richard A. Smith, Lansing, Mich.**

Present position: Asst. Geol. of Mich.

Proposed by R. C. Allen, O. W. Wheelwright, Leslie P. Barrett.

Born 1876, Dewitt, Mich. 1893, Lansing Business Univ. 1899-1903, Mich. Normal College. 1907-11, Univ. of Mich., A. B. 1911-19, Asst. State Geol. of Mich. 1911-13, Investigation of oil & gas resources of Mich. 1911-17, Reports on non-metallic resources of Mich. 1911-14, Coal of Mich. & gypsum of Mich. 1913-15, Investigation of limestone resources of Mich. 1914-16, Coal in Mich. Report on coal resources of U. S.

**William Sidney Tangier Smith, Palo Alto, Calif.**

Present position—1912 to date: Cons. Geol.

Proposed by F. L. Ransome, C. E. Siebenthal, Frank L. Hess, N. H. Darton.

Born 1869, Stockton, Calif. 1886-90, Univ. Calif. 1890-91, Johns Hopkins Univ. 1892-96, Univ. of Calif., B. L., Ph. D. 1895-97, Teaching Fellow in Mineralogy, Univ. Calif. 1897-98, Field Asst., U. S. Geol. Survey. 1899-1900, Asst. in Mineralogy, Univ. Calif. 1900-05, Asst. Geol., U. S. Geol. Survey. 1906-12, Prof. of Geol. & Mineralogy, Univ. of Nev.

**Raymond Spillsbury, La Fundicion, Peru.**

Present position—1918 to date: Asst. Met. Supt., Cerro de Pasco Copper Corpn.

Proposed by Chester Atkinson, T. W. Mather, J. M. Boutwell.

Born 1888, Toquerville, Utah. 1910-14, Univ. of Utah, B. S. 1914-15, Chem.; 1915-17, Chief Chem.; 1917-18, Smelter Foreman, Cerro de Pasco Copper Corpn.

**William James Sullivan, Freeport, L. I.**

Present position—1903 to date: Sec. to Pres., United States Steel Corpn.

Proposed by W. R. Walker, C. A. Meissner, J. H. Ruiloba.

Born 1880, Hamilton, Ont., Canada. 1895, De La Salle Inst., Hamilton, Ont., Canada. 1897, Collegiate Inst. 1898, Commercial High. 1898-99, Monessen Steel Co., Pittsburgh, Pa. 1899, Carnegie Steel Co., Keystone Plt. 1900-03, Sec. to Pres., Carnegie Steel Co., Homestead Wks.

**Farquhar Tait, Perak, Fed. Malay States.**

Present position: Asst. Min. Engr. prospecting with instructions of Mr. C. H. Munro.

Proposed by J. F. Newman, C. H. Munro, F. L. Morris.

Born 1887, Edinburgh, Scotland. 1900-05, Morrissia Academy, Crieff, Scotland. 1905-09, Heindt Habb College, Edinburgh, Scotland. 1905-09, Edinburgh Univ. 1905-09, Civil Engr., Papilage. 1909-13, Civ. Eng., professional practice, on own account. 1913-16, Asst. Engr. Public Wks., Dept. Fed. Malay States Govt. 1916-17, Gen'l Engr., Asst. Malayan Tin Dredging Co., Ltd., Fed. Malay States. 1917-18, Gen'l Engr. Asst. and Mine Prospector for Wm. Killie Smith. 1918-19, Prof. practice civil, mining and mechanical engr.

**Alfred C. Torgerson, Anaconda, Mont.**

Present position: Mgr., Anaconda Copper Min. Co., Anaconda, Mont.

Proposed by Harry S. Ware, Ernest Klepetko, H. L. Welsh.

Born 1892, Havggesund, Norway. 1906-12, Manchester, Eng. 1912-16, Asst. Valuer with British Govt., 2 yr., Chief Asst. to valuer. 1916-17, Draftsman, Engrg. & Drafting Dept., Anaconda Copper Min. Co.

**Burt Adams Tower, Butte, Mont.**

Present position—1916 to date: Chief Engr., Davis-Daly Copper Co.

Proposed by W. L. Creden, C. H. Clapp, F. A. Linforth.

Born 1878, Cambridge, Mass. 1899-1903, Harvard Univ., A. B. & A. M. 1899-1906, Min. Engr., Montana Ore Purchasing Co. 1906-07, Cons. Min. Engr. 1907-09, Independent min. operations. 1909-10, Ruby irrigation project. 1910-11, City engr., Dillon, Mont. 1914-16, Cons. Min. Engr.

**Stanley Travis, London, England.**

Present position: Chief Engr., Denny Chem. Engrg. Co.

Proposed by H. S. Denny, George Denny, Francis Drake.

Born 1884, Eccles, England. 1889-97, Elem. Sch. 1897-99, Higher Grade Sch. 1899-1904, Tech. Sch. 1911-13, Charge of gas power sta. 1913-17, Engr. in charge of all outside wk., colliery & blast-furnace wk. 1918-19, Power House Mgr., H. M. Factory, Langworth.

**Carl Hans Vom Baur, Douglaston, N. Y.**

Present position: Cons. & Mfr., Vom Baur Elec. Furnaces.

Proposed by H. C. Parmelee, Joseph W. Richards, Richard Moldenke.

Born 1878, New York. 1895-99, Columbia Univ. 1899-1900, Darmstadt, special courses at M. I. T. & Brooklyn Poly. Inst., E. E. With Gen'l Elec. Co. 1910-12, Mgr. & Chief Engr., Amer. Elec. Furnace Co. 1912-15, Cons. wk. 1915-17, Mgr., Elec. Furnace Dept, Hamilton & Hansell, New York, N. Y. 1917-18, C. H. Vom Baur Cons. 1918-19, Vice-pres., Price Engrg. Co., New York, N. Y. 1919 to date, C. H. Vom Baur, Mfrs.

**Johan Christian Wibe von Krogh, Indre Aalvik, Hardanger, Norway.**

Present position—1917 to date: District Mgr. at Bjalnepassues Carbide Factory.

Endorsed by American Electrochemical Society.

Born 1882, Hevne, Norway. Grad. in 1903, Trondhiems Technical School. 1903, Practice at Dunderland Trau ore work, Norway. 1904, Draftsman, Hapslund, Norway. 1905-07, American Car & Foundry Co., Mo. 1907-16, Dist. Mgr., Usines Electrochimiques de Hapslund.

**Laurence Peters Weld, Lead, S. D.**

Present position: Asst. on Surface Surveys.

Proposed by Charles A. Brooks. A. J. Blackstone, A. L. Coolidge.

Born 1890, Albion, N. Y. 1908-12, New Mexico State Sch. of Mines, Socorro, N. M., E. M. 1912-13, Asst. Engr., Original Amador Cons. Mines Co., Amador City, Calif. 1913-14, Smelter Chem., Mason Valley Mines Co., Thompson, Nev. 1915-16, Miner & Millman, several small Colorado leasers; Clear Creek, Summit & Lake Counties. 1916-17, Engrg. Dept., Homestake Min. Co., Lead, S. D. 1917-19, 27th Engrs., U. S. A. 1919, Engrg. Dept., Homestake Min. Co.

**Robert Youngblood Wert, Soddy, Tenn.**

Present position—1915 to date: Chief Engr., Durham Coal & Iron Co.

Proposed by W. T. Jones, Louis S. Colyar, W. M. Lasley.

Born 1883, Moulton, Ala. 1890-1900, Public School, Chattanooga, Tenn. 1900-02, Univ. of Tenn. 1902-05, Asst. Engr., New Soddy Coal Co. 1905-06, U. S. A. 1906-07, Asst. Engr., New Soddy Coal Co. 1907-08, Asst. Engr., St. Louis, Montasno & Son Ry. 1908-13, U. S. A. 1914-15, Keystone Lubricating Co.

**Willard O. White, Uniontown, Pa.**

Present position—1918 to date: Chief Engr., W. J. Rainey.

Proposed by Thomas W. Dawson, L. L. Willard, C. N. Lingle.

Born 1876, Delta, N. Y. 1893-96, Cazenovia Sem. 1896-1900, Cornell Univ., C. E. 1900, summer, Chairman & Rodman, Central R. R. of N. J. 1900-01, Draftsman, Amer. Coke Co. 1901-03, Asst. Div. Engr., H. C. Frick Coke Co. 1904-07, Draftsman & Asst. Engr., N. Y. State Canals. 1907-10, Chief Engr., Tower-Hill Connellsville Coke Co. 1910-16, Practice for self, Cons. Civil & Min. Engr., Uniontown, Pa. 1916-18, 1 yr., Field Engr., Hubbard Furnaces, Youngstown Sheet & Tube Co., transferred to Carmichaels, Pa. 1 yr. on constr. of Wemacolin Pit.

**Robert Brooks Whitehead, Dallas, Tex.**

Present position: Chief Geol., Atlantic Oil Prod. Co.

Proposed by Charles T. Kirk, Edmund Robitaille, E. H. Blum.

Born 1889, Mt. Pleasant, Mich. 1912, Central State Normal School. 1915-16, Univ. Chicago, B. S. 1912-13, Head of Science Dept., Lake-view High School, Mich. 1913-15, Head, Science Dept., St. Joe High School, Mich. 1915-16, Asst. Geography Dept., U. of C. Chicago. 1916-18, Asst. Chief Geol., Empire Oil & Gas Co. 1918-19, Chief Geol., Atlantic Oil Prod. Co.

**Asa Williams Whitney, Bristol, Tenn.**

Present position—1909 to date: Met., Enterprise Foundry & Machine Works.

Proposed by H. M. Howe, Albert Sauveur, William R. Webster.

Born 1861, Philadelphia, Pa. 1869-79, Private Tutors. 1879-82, Mass. Inst. of Tech. 1883-84, Special chem. course, Univ. of Pennsylvania. 1884-96, Analyst, Student Advisor, Met., A. Whitney & Son's, Car Wheel Works. 1894-1903, Wrote various articles on cast iron for A. I. M. E., Foundrymen's Assn., Franklin Inst. 1898-1900, Met. & Supt., Whitney Car Wheel Works, Philadelphia, Pa. 1900-09, Cons. work, various firms. 1901, Asst. to Prof. Sauveur.

**Sidney David Williams, Harrisburg, Pa.**

Present position—1918 to date: Asst. Supt., Open Hearth Dept., Central Iron & Steel Co.

Proposed by Lewis B. Lindemuth, Frank D. Carney, Joseph W. Richards.

Born 1891, New York, N. Y. 1909-13, Lehigh Univ., E. M. 1913-15, Apprenticeship, Homestead Steel Wks., Carnegie Steel Co., Munhall, Pa. 1915-18, Asst. Supt., Open Hearth No. 4, Homestead Steel Wks.

**Richard William Wilson, Lehigh, Mont.**

Present position—1917 to date: Gen'l Mgr., Cottonwood Coal Co.

Proposed by Charles E. Locke, Robert W. Richards, Richard W. Lodge.

Born 1879, Sunderland, England. Public Sch., Carnegie, Pa. 3 yr., special, Mass. Inst. Tech. 1895-1900, Engrg. Office, Rodman, Chairman, Pittsburgh, Pa. 1900-01, Constr. wk., Crows Nest Pass Coal Co., Fernie, B. C., Canada & Mine Foreman, Mickel & Morrissey. 1902-04, Mgr., Cornelia mine, Veremiging Estates, Ltd., South Africa. Worked in mill & cyanide plt., Johannesburg, S. A. 1904-07, summer, Cobalt Co., prospecting. 1907-15, Supervising devel. wk. & reporting min. claims, Northern Ont., B. C. & Que. 1915-17, Supt., Aetna Chem. Co., Carnegie, Pa.

**Richard Laurence Witcomb**, Chuquicamata, Chile.

Present position—1918 to date: Min. Engr., Chile Exploration Co.

Proposed by Warren D. Thompson, J. Gordon Mason, J. E. Shaw.

Born 1884, Middlesex, England. 1912-14, Mgr., Anglo-Bolivian Trading Co., Oruro, Bolivia. 1914-18, Mgr., Mina Emilia, Mgr. & Engr. copper mine, Chuquicamata, Chile.

**William John Wooldridge**, Portsmouth, Ohio.

Present position: Mgr., Electrical Sheet Dept., Whitaker-Glessner Co.

Proposed by W. E. Ruder, W. R. Whitney, K. A. Pauly.

Born 1873, Cornwall, England. 1887-91, Melrose, Mass., High Sch. Special course, Mass. Inst. of Tech. 1892-95, Student course. 1895-1919, Transformer Engrg. Dept., General Elec. Co.

**William John Woolsey**, Quebec, Canada.

Present position—1916 to date: Inspector & Engrg. Dept., Asbestos Corp. of Canada.

Proposed by Hugh B. Lee, R. N. Palmer, F. R. Brooks.

Born 1869, Sherbrooke, Que. 1907, School of Mines, Queens Univ., Kingston, Ont., B. Sc. 1898-1901, Supt., Union Asbestos mines, Black Lake, Que., Canada. 1902-07, Supt., Amer. Asbestos Co., Black Lake, Ont., Canada. 1907-09, Supt., Airgoid Silver Co., Cobalt, Ont. 1909, Miner, timbering & met. study, Granby Copper Co., Phoenix & Grand Forks, B. C. 1909-11, Mgr., Robertson Asbestos Co., Robertson Sta., Que. 1911-13, Sales Agent, in Europe, Johnson's Asbestos Co. in Europe. 1913-16, Contr. & Operator, Chrome.

**Howard Gregory Wright**, New York, N. Y.

Present position: Engr., Famatina Min. Corp., Argentina & N. Y.

Proposed by Charles H. Urquhart, E. P. Mathewson, F. D. Aller.

Born 1882, Hancock, Mich. 1898-1900, Hancock High Sch. 1902-05, Mich. College of Mines. 1905-07, Draftsman, various companies. 1907-09, Mill Supt., Keweenaw Copper Co., Calumet, Mich. 1909-10, Supt., Zinc Concentrator, National Ore Concentration Co., Joplin, Mo. 1910-11, Supt., diamond-drill operations, Sente-Dupee Devel. Co., Calumet, Mich. 1911-13, Draftsman; 1913-15, Chief Draftsman, H. Koppers Co., Chicago, Ill. 1915-16, Supt., Smelter Constr., Anaconda Copper Min. Co., Anaconda, Mont. 1916-18, Engrg. Dept., U. S. Smelt Co., Salt Lake City, Utah. 1918, Charge of depts., U. S. Smelt. Co., Midvale, Utah & Supt. Roasters. 1918, 1st Lieut., Engrs., U. S. A. 1919, Senior Mech. Engr., Valuation Industrial Plts., Ford, Bacon & Davis, N. Y.

**Trygve D. Jensen**, Pittsburgh, Pa.

Present position—1916 to date: Research Met., Westinghouse Elec. & Mfg. Co.

Proposed by Jesse L. Jones, J. W. Richards, Bradley Stoughton.

Born 1884, Drammen, Norway. 1900-03, Kristiania Cathedral Sch. 1903-07, Univ. of Ill. 1910-16, Univ. of Ill., B. S. 1907-08, Sp. Apprentice, Gen. Elec. Co. 1908-09, Instructor Electr. Engrg., Univ. of Ill., Urbana, Ill. 1909-10, Elect. Engr., Shawinigan Water & Power Co., Montreal, Can. 1910-15, 1st Asst., Engrg. Exper. Sta., Univ. of Ill. 1915-16, Research Asst. Prof. of Elect. Engr., Univ. of Ill.

**George Samuel Young**, San Francisco, Calif.

Present position—1917-19: Capt., Engrs., U. S. A.

Proposed by Ernest A. Hersam, Walter Stalder, W. S. Morley.

Born 1883, San Francisco, Calif. 1897-1900, Calif. School of Mech. Arts. 1900-04, Univ. of Calif., B. S. 1904-05, Assay Dept., Yellow Aster mine, Randsberg, Calif. 1906, Assay Dept., Tuolumne Co., Calif. 1906, Engr., Tuolumne Co., Nev. 1906-07, Engr., Grant R. Davis, Manhattan, Nev. 1907-09, Genl. engr. practice, Seattle, for self. 1909, Chief field party, Pacific Gas & Elec. Co., San Francisco, Calif. 1909-17, Genl. practice, Civil, Min. & Hydraulic Engrg. in business for self, Bend, Ore.

**Rufus Eicher Zimmerman**, Pittsburgh, Pa.

Present position: Director, Research Lab., Amer. Sheet & Tin Plate Co.

Proposed by F. N. Speller, Joseph W. Richards, Fred Crabtree.

Born 1883, Mt. Pleasant, Pa. 1904-08, Franklin & Marshall College. 1909-11, Mass. Inst. of Tech., Ph. B., S. B. 1911-12, Asst. in Analytical Chem., Mass. Inst. of Tech. 1912-14, Instr., Theoretical Chem., Mass. Inst. Tech. 1914-19, Research Lab., Amer. Sheet & Tin Plate Co. as Research Assoc., Asst. Director, Acting Director, Director.

**William G. Zulch**, Denver, Colo.

Present position: Min. Engr., Vindicator Cons. G. M. Co.

Proposed by Louis S. Noble, George A. Stahl, W. E. Ryan.

Born 1890, Boulder, Colo. 1908-14, Colo. Sch. of Mines, E. M. 1914-15, Geol., Golden Cycle Min. Co. 1915-17, Min. Engr. 1917-18, Flotation Mill Foreman. 1918 to date, Field Engr., Vindicator Cons. G. M. Co.

### *Associates*

**George Leonard Adair**, Madison, Wis.

Present position: Geol., Wis. Geol. Survey.

Proposed by A. N. Winchell, C. K. Leith, W. J. Mead.

Born 1895, La Crosse, Wis. 1916-18, Univ. of Wis. 1914-16, La Crosse Normal Sch. 1916-18, Univ. of Wis., B. A. 1918, Compassman, Wis. Geol. Survey, Madison, Wis.

**Harry Aid**, Gallatin, Mo.

Present position: Instrumentman, Harrison & Eaton, Ft. Worth, Tex.

Proposed by Horace T. Mann, A. L. McRae, M. H. Thornberry.

Born 1897, Gallatin, Mo. 1911-15, Gallatin Public Sch., Gallatin H. Sch. 1915-19, Missouri School of Mines. 1916, Surveying, C. R. I. & P. Ry. 1917, Solution-man, Teck Hughes Gold Mines, Ltd., Ont., Canada. 1917-18, Field Asst., U. S. Geological Survey, So. Carolina. 1918-19, Air Service, U. S. A.

**Fred Tyler Bragonier**, Bisbee, Ariz.

Present position—1917 to date: Private Sec'y, Ariz. Chapter, American Min. Congress, Bisbee, Ariz.

Proposed by H. C. Henrie, Harry M. Ziesemer, W. B. Gohring.

Born 1877, Middletown, Md. 1885-94, Public Schools, Baltimore City, Md. 1894-95, Bryant-Stratton Business College, Baltimore, Md. 1895-96, Student & Clerk, Cromwell Steamship Co., Baltimore, Md. 1896-98, Clerk & Chief Clerk & Gen'l Agent, So. Ry. Co., Baltimore, Md. 1899-01, Clerk, Copper Queen Cons. Min. Co., Bisbee, Ariz. 1901, Prospecting in Sonora, Mexico. 1901-03, Gen'l Min. Clerk, Calumet & Ariz. Min. Co., Bisbee, Ariz. 1903-04, Opened copper-lead property on Turkey Creek, Churicahua Mts., Ariz. 1905-06, Prospecting in Central Ariz. 1907-11, Established firm of Armstrong & Bragonier, Parker, Ariz. Prospecting, Western Ariz. (Colo. River). 1912-15, Prospecting Mohave Co., Ariz. Sec'y, Clarissa Gold Min. Co., Oatman, Ariz. 1916, Mgr., Nancy Lee Min. Co., Secret Pass, Ariz. 1917, Pres., Nancy Lee Co.

**Richard Gardiner Casey**, Melbourne, Aust.

Present position: Student, Australasian Institute of Min. Engrs.

Proposed by A. A. Boyd, James Horseburgh, B. G. Patterson.

Born 1890, Brisbane, Queensland, Australia. 1909-10, Melbourne Univ. 1910-13, Cambridge Univ., B. A. 1914, Asst. Geol., Mt. Morgan Gold Min. Co., Ltd., Mt. Morgan, Australia. 1914-19, Major, Australian Army.

**Donald Simonds Clements**, New Haven, Conn.

Present position: Student.

Proposed by John R. Freeman, Jr., Howard Scott, C. H. Mathewson.

Born 1897, Madison, Wis. 1914-17, Carnegie Tech. 1917-19, Yale Univ., Ph. B. 1918, Lab. Asst., Bureau of Standards, Washington, D. C. 1919, Lab. Asst., Heat Treatment, Bureau of Standards, Washington, D. C.

**Carl E. David**, Cleveland, Ohio.

Present position: First Lieut., Engrs., U. S. A.

Proposed by Charles H. Fulton, Frank D. Van Horn, A. W. Smith.

Born 1895, Cleveland, Ohio. 1913-17, Case Sch. of Applied Science, B. S. 1917-19, U. S. Army.

**Gilbert Everett Doan**, Annapolis, Md.

Present position: Met., U. S. Naval Engrg. Expt. Sta.

Proposed by D. J. McAdam, Jr., Henry S. Drinkwater, Joseph W. Richards.

Born 1897, Lansdale, Pa. 1915-19, Lehigh Univ., Ch. E. 1915-17, summers, Lecturing & Salesman, Aluminum Cooking Utensil Co. 1918, summer, Met. Lab., U. S. Naval Engrg. Experiment Sta.

**Everett Carlyle Edwards, Madison, Wis.**

Present position—1918 to date: Geol. & Chief of Party, Wis. Geol. Survey.

Proposed by A. N. Winchell, C. K. Leith, W. J. Mead.

Born 1897, Ashland, Wis. 1914-16, Carroll College. 1916-18, Univ. of Wis., B. A. 1917, Compassman & Geol. 1918, Geol. & Chief of Party. 1919, Geol. & Chief of Party, Wis. Geol. Survey.

**Ernest David Fahlberg, Madison, Wis.**

Present position: Instructor in Chemical Engrg.

Proposed by A. N. Winchell, Edwin L. Shorey, Richard S. McCaffery.

Born 1890, Beresford, S. D. 1914-18, Univ. of Wis., B. S.

**Edwin Conklin Foster, Philadelphia, Pa.**

Present position—1918 to date: Asst. Mgr., Ferro Alloys Dept., E. J. Lavino & Co.

Proposed by F. D. Dimmick, Richard Peters, Jr., William W. Hearne.

Born 1893, Pleasantville, N. Y. 1909-11, Peekskill Military Academy. 1911-12, Westtown Sch. 1912-13, Phillips Brooks Sch. 1913-17, Mineralogist & Salesman, Foote Mineral Co., Inc. 1917, Salesman, Shimer & Co., Inc., Sales Agent, Amer. Manganese Mfg. Co., Philadelphia, Pa.

**Philip Goldstein, London, England.**

Present position: Principal, Clerkenwell Plating Wks.

Endorsed by Amer. Electrochem. Soc.

Born 1871, London, England. London Public Schools. 25 yr., prin. engaged in electrodisposition of all metals & engrg. 5 yr., Member of Amer. Elec. Soc.

**Sidney Harris, Chicago, Ill.**

Present position—1918 to date: Asst. Supt., Mineral Separation & Refin. Co., Indiana Harbor, Ind.

Proposed by Milo W. Krejci, James O. Johnstone, G. P. Hulst.

Born 1898, Salt Lake City, Utah. 1912-16, Univ. High. 1916-18, Armour Inst. of Tech. 1918-19, Met. Chem., Smelter & Asst. Supt., Minerals Separation & Refin. Co.

**Clarence Edgar Hyde, Shreveport, La.**

Present position: Geol., Marland Refin. Co., Gulf Coast & Northern La.

Proposed by S. C. Stathers, Burton Hartley, Fred B. Plummer.

Born 1894, Washington, Mo. 1910, Austin College. 1911-14, Okla. Univ., B. A. 1913, Field Geol., Okla. Geol. Survey. 1915-17, Field Geol., Roxana Pet. Co., also 1st Lieut., U. S. A. 1919, Geol., Roxana Pet. Co. of Okla.

**Walther Llewellyn Jerrard, Hibbing, Minn.**

Present position: Asst. Min. Engr., Dept. of Mineral Lands, State of Minn.

Proposed by Guy E. Ingersoll, A. P. Sillman, Gustave A. Jahn.

Born 1895, St. Cloud, Minn. 1910-14, St. Cloud High Sch. 1914-18, Sch. of Mines, Univ. of Minn., E. M. 1916, Underground Miner, Oliver Iron Min. Co. 1917, Transitman, drainage work, and levelman, Chute & Bradley, Engrs., St. Cloud, Minn. 1918, Chem. Warfare Section, U. S. A.

**Henry A. Johann, St. Louis, Mo.**

Present position—1897 to date: Dealer Min. Machinery.

Proposed by Charles E. Schwarz, Arthur Thacher, O. M. Bilharz.

Born 1864, Pacific, Mo. 1881-83, Washington Univ. 1897-14, Sales Engr., Taylor Wharton Iron & Steel Co., High Bridge, N. J.

**George Herbert Jones, Chicago, Ill.**

Present position: Vice-pres., Inland Steel Co.

Proposed by F. S. Peabody, George B. Harrington, Robert W. Hunt.

Born 1856, London, England. Private schools, England. Owner Hillside fluorspar mines, Elizabethtown, Ill., for past 20 years, Vice-pres., Inland Steel Co., Chicago, Ill.

**Eugene Call Knowles, San Francisco, Calif.**

Present position: Chem., Exide Battery Depots Inc.

Proposed by Henry Hanson, Frank L. Sizer, Edwin Higgins.

Born 1883, Oakland, Calif. 1894-1902, St. Matthews Military School. 1902-06, Univ. of Calif. 1905-06, Assayer, Laconia Min. Co., Delta, Calif. 1906-07, Cyanide

Operator Night Boss, Sierra Butte mines, Calif. 1907-08, Cyanide Operator, slime plant, Homestake Min. Co., Lead City, S. D. 1908-14, Chem., Merrill Met. Co., San Francisco, Calif. 1914, Met. Engr., Atlas Wonder Min. Co., Wonder, Nev. & Cyanide Operator, Empire Mines Co., Grass Valley, Calif. 1914-15, Supt., Hammond Min. Co., Glacier, Wash. 1915, Cyanide Operator, Original Amador Mines Co., Amador City, Calif. 1915-18, Min. Engr., South Eureka Min. Co., Suter Creek, Calif.

**Harold D. Lehr**, Bethlehem, Pa.

Present position—1918 to date: Experimental Wk., as Engr., Combustion Engrg. Dept., Bethlehem Steel Co.

Proposed by G. A. Roush, Allison Butts, R. M. Bird.

Born 1896, Bethlehem, Pa. 1909-13, Bethlehem High Sch. 1913-18, Lehigh Univ., Electromet. 1918 to date, Experimental wk. on boilers, gas producers, furnaces & steam engines, Bethlehem Steel Co.

**Eugene Lilly**, St. Paul, Minn.

Present position: Geol., The Greenwood Co.

Proposed by F. G. Jewett, R. S. Hazeltine, W. H. Emmons.

Born 1894, St. Paul, Minn. 1914-19, Univ. of Minn., B. S. 1917-18, Capt., Field Artillery, U. S. A.

**Clyde Francis Lyons**, Butte, Mont.

Present position—1918 to date: Research Dept., Timber Butte Mill. Co.

Proposed by Geo. G. Griswold, Jr., G. E. Sheriden, Hamilton Cooke, Jr.

Born 1888, Springfield, Mo. 1904-08, Conception College. 1908-12, Mo. Sch. of Mines. 1911, Mucker, Miner, Goldfield Cons. Mines Co., Goldfield, Nev. 1912, Solutionman, Goldfield Cons. mill. 1912-13, Shift Foreman, Rainbow mill, U. S. Smelt. Co., Rye Valley, Ore. 1913-16, Assayer, Goldfield Cons. Mines Co. 1916-17, Assayer; 1917-18, Testing Dept.; 1918-19, Research Dept., Timber Butte Milling Co.

**Donald Asire MacKay**, London, England.

Present position—1914 to date: Captain, Australian Field Engrs.

Proposed by Philip S. Moore, David Baker, Gilbert Rigg.

Born 1894, Peru, Ill. 1905-11, Melbourne Grammar Sch. 1912-14, Sydney Univ.

**Daniel Tate MacLeod**, Milwaukee, Wis.

Present position—1917 to date: Vice-pres., Operations Elkhorn Piney Coal Min. Co. & St. Clair Coal Min. Co.

Proposed by Ferdinand Schlesinger, C. W. Andrews, C. W. Atwater.

Born 1873, Canton, Mass. 1890, Cambridge Manual Training Sch. 1912-13, Univ. of Pa. 1891-98, Draftsman & Chief Draftsman, Arch Div., West End St. Ry. Co. & Boston Elev. Ry. Co. 1898-99, Draftsman, Westinghouse Church, Kerr & Co., New York, N. Y. 1898-1915, Asst. Engr. & Chief Engr., United Coke & Gas Co., Amer. Coke & Gas Constr. Co., Otto Coking Co. 1915 to date, Pres., Hamilton By-products Co. 1915-17, Cons. Engr., New York, N. Y.

**William T. Mitman**, New Kensington, Pa.

Present position: In training for position of Technical Supervisor.

Proposed by R. V. Davies, Henry S. Drinker, Joseph W. Richards.

Born 1897, Bethlehem, Pa. 1914-18, Lehigh Univ., El. M. 1918, summer, Control Chem., carbid elec. furnaces, Air Nitrates Corp., N. Y. 1918-19, Cons. & operation of carbid elec. furnaces, Ord. Dept., U. S. A. 1919, Tech. Direction Dept., Aluminum Co. of America.

**Wen Ping Pan**, Minneapolis, Minn.

Present position: Homestake Mines, Lead, S. D.

Proposed by W. R. Appleby, Peter Christianson, E. H. Comstock.

Born 1893, Peking, China. 1918-19, Univ. of Minn., Met. E.

**William Wolsey Raymond**, Eulalia, Chih., Mexico.

Present position: Engr., The Buena Tierra Min. Co., Ltd.

Proposed by Paul Steger, C. Q. Schlereth, A. C. Brinker.

Born 1886, St. John, N. B., Canada. 1904, St. John High School. 1905, Univ. of New Brunswick. 1912, McGill Univ., B. Sc. 1908-09, Assayer & Surveyor, Kerr

**Lake Min. Co., Cobalt, Ont., Canada.** 1909, Surveyor & Draftsman, Asbestos & Asbestic Co., Asbestos, Que. 1910, Asst. Supt., Black Lake Cons. Asbestos Co., Black Lake, Que. 1911, Assayer, Temiskaming Min. Co., Cobalt, Ont., Canada. 1912-13, Engr., Frood & Garson mines, Mond Nickel Co., Coniston, Ont. 1913-14, Engr., Buena Tierra Min. Co., Eulalia, Mex. 1914-19, Lieut., Canadian Ex. Forces.

**Richard Russell Rees, Troy, N. Y.**

Present position: Asst. to Enrique Touceda, Cons. Engr., Albany, N. Y.

Proposed by Benjamin G. Harmon, Enrique Touceda, Palmer C. Ricketts.

Born 1892, Erie, Pa. 1910-12, Kingsley Sch., Essex Falls, N. J. 1912-16, Rensselaer Poly. Inst., Troy, N. Y. 1916-17, Research Chem., The Barrett Co. 1917-19, Chief Chem., Watervliet Arsenal, Watervliet, N. Y. 1919, Cons. Engr. & Met., Enrique Touceda, C. E. & Cons. Engr., Amer. Malleable Castings Assoc.

**Walter Richard Carl Russert, Boston, Mass.**

Present position: Flotation Operator, Butte & Superior Co.

Proposed by C. W. Goodale, E. V. Daveler, G. N. Bennett.

Born 1896, New York, N. Y. 1914-17, Mass. Inst. Tech. 1917-19, Yale Univ., Ph. B. 1917, summer, Miner, Repairman, Anaconda Copper Co. 1918, Engr., Reserve Corps.

**William Michael Schaill, New York, N. Y.**

Present position—1915 to date: Mgr., Carib Syndicate Ltd., Columbia, S. A.

Proposed by C. J. London, K. C. Parrish, Harvey B. Small.

Born 1880, Oramel, N. Y. 1898, Public Schs., Lima, Ohio. 1907-08, Oil field wk., Balfour Williamson & Co., Peru, S. A. 1908-11, Oil field wk., Standard Oil Co., & Bohemian Co., Calif. 1911-15, Field Rep., oil companies, Columbia, S. A.

**John A. Shelton, Butte, Mont.**

Present position: Min. Atty.

Proposed by Horace V. Winchell, Reno H. Sales, Samuel Barker, Jr.

Born 1866, Fairfield, Idaho. 1889, International Sch. Corres., Ames, Idaho. 1892, Univ. of Mich., Ann Arbor, Mich., B. S., M. S.

**Arthur Earl Stander, Tulsa, Okla.**

Present position: Pet. Geol., Texas Co., in Osage Co. & Lawton field of Okla.

Proposed by A. N. Winchell, W. J. Mead, Stephen Royce.

Born 1889, Cresco, Iowa. 1910-14, Iowa State Teachers College. 1914-17, Univ. of Wis. 1917-18, Asst. Geol. 1918, 4 mos., Pet. Geol., The Texas Co. 1918, U. S. Navy.

**Ward Edward Wampler, Cartersville, Mo.**

Present position: Mgr., Amer. Zinc Lead & Smelt. Co.

Proposed by Howard I. Young, Charles B. Strachan, M. H. Newman.

Born 1889, Schell City, Mo. 1896-1904, Prosperity Public School, Prosperity, Mo. 1905-07, Great Western College, Webb City, Mo. 1909-10, Joplin Business College, Joplin, Mo. 1910, Stenographer; 1914-19, Cashier; 1919, Mgr., Amer. Zinc Lead & Smelt. Co.

**Ronald Webster, Evanston, Ill.**

Present position—1918 to date: Asst. Director, Research Lab., Fansteel Products Co., Inc., No. Chicago, Ill.

Proposed by Francis G. Fabian, H. L. Hollis, Bradley Stoughton.

Born 1890, Evanston, Ill. 1908-12, Williams College, B. A. 1912-16, Editorial writer, *The Chicago Tribune*. 1916-18, Major, U. S. Army.

### Junior Associates

**Herman Isadore Albert, Rolla, Mo.**

Present position: Student, Mo. Sch. of Mines.

Proposed by M. H. Thornberry, G. H. Cox, C. R. Forbes.

Born 1899, Bessarabia, Russia. 1913-17, Central High Sch., St. Louis, Mo. 1917, Mo. Sch. of Mines.

**Milton Nunn Bramlette**, Madison, Wis.

Present position: Student, Univ. of Wis.

Proposed by W. J. Mead, A. N. Winchell, Richard S. McCaffery.

Born 1896, Bonham, Tex. 1916-19, Univ. of Wis.

**Julian Darst Conover**, Madison, Wis.

Present position—1917 to date: Major, Coast Artillery Corps, U. S. A.

Proposed by C. K. Leith, W. J. Mead, A. N. Winchell.

Born 1895, Madison, Wis. 1909-13, Madison High Sch. 1913-17, Univ. of Wis., A. B. 1914, summer, Compassman, Wis. Geol. Survey. 1915-17, Asst. field & office work.

**William Earl Dunn**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. Sperr, F. W. McNair.

Born 1899, Portland, Ore. 1913-17, Lewis & Clark High School, Spokane, Wash. 1918, Mich. College of Mines.

**Richard Merrill Hall**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. Sperr, F. W. McNair.

Born 1898, Spokane, Wash. 1913-17, Lewis & Clark High School. 1918 to date, Mich. College of Mines.

**Ernest Ludwig Hallbauer**, Urbana, Ill.

Present position: Student, Univ. of Ill.

Proposed by H. H. Stoek, J. Burns Read, J. R. Fleming.

Born 1898, Regis, Germany. 1913-17, Lane Tech. High, Chicago, Ill. 1917-19, Armour Inst. & Univ. of Ill.

**Robert Mille Heinrich**, Champaign, Ill.

Present position: Student, Univ. of Ill.

Proposed by H. H. Stoek, J. Burns Read, J. R. Fleming.

Born 1900, Fort Wayne, Ind.

**John Frederick Holmes**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. Sperr, F. W. McNair.

Born 1886, Minneapolis, Minn. 1905-09, Univ. of Mich. 1918-19, Mich. College of Mines. 1909-11, Engr. & Asst. Supt., Bloomington Coal Co., Bloomington, Md. & Western Maryland Coal Co., Blain, W. Va. 1914-15, Efficiency engrg. wk. underground, Calumet & Hecla Min. Co., Calumet, Mich.

**John Leslie Howendobler**, Tulsa, Okla.

Present position: Student, Mo. Sch. of Mines.

Proposed by M. H. Thornberry, Charles Y. Clayton, A. L. McRae.

Born 1894, Perry, Okla. Tulsa High Sch. 1919, Rodman, Cosden Oil Co., Cisco, Tex.

**William Randolph McComb**, Rolla, Mo.

Present position: Student, Missouri School of Mines.

Proposed by Charles Y. Clayton, M. H. Thornberry, C. R. Forbes.

Born 1893, Dixon, Mo. 1913-14, Missouri School of Mines. 1915-17, Mine Foreman, Assayer, Engr. 1917-18, Asst. Chem., Phelps-Dodge Corp., Morenci, Ariz.

**Simon Merenbach**, Reno, Nev.

Present position: Student, Mackay Sch. of Mines, Univ. of Nev.

Proposed by J. C. Jones, Walter S. Palmer, F. C. Lincoln.

Born 1891, Theodosia, Russia. 1908-09, Public Sch.; 1909-13, High Sch., New York, N. Y. 1913-15, Univ. of Cal. 1916-18, Univ. of Nev. 1917, summer, Surveyor & Mine Sampler, Rochester Combined Mines Co., Packard, Nev. 1918, Millman, Tonopah-Belmont Mines, Tonopah, Nev. 1918-19, Chem., Chemical Warfare Service, U. S. A., Cleveland, O. 1919, Field Agent, Southern Pacific Land Co.

**Frank Rockwell Morris**, Columbus, Ohio.

Present position: Student, Ohio State Univ.

Proposed by H. E. Nold, D. J. Demorest, William J. McCaughey.

Born 1899, Huntington, W. Va. 1914-16, Augusta Military Academy, Ft. Defiance, Va. 1917-18, Transitman, Gauley Mt. Coal Co., Jodie, W. Va. 1918-19, C. A. C., U. S. A., 2d Lieut. 1919, Asst. Engr., Gauley Mt. Coal Co.

**George F. O'Brien**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. Sperr, F. W. McNair.

Born 1899, Brainerd, Minn. 1913-17, St. John's Univ. 1917, Mich. College of Mines.

**Earl S. Prince**, Madison, Wis.

Present position: Student, Univ. of Wis.

Proposed by Richard S. McCaffery, A. N. Winchell, W. J. Mead.

Born 1894, Downers Grove, Ill. 1914, Wis. Univ. Left college and reentered in 1919.

**Ben Lee Raiff**, Golden, Colo.

Present position: Student, Colo. Sch. of Mines.

Proposed by J. C. Roberts, Victor C. Alderson, J. A. Palmer.

Born 1898, Big Timber, Mont. 1917, Bellings High Sch., Bellings, Mont. 1917, Colo. Sch. of Mines.

**Julius Clarence Salmon, Jr.**, Rolla, Mo.

Present position: Student, Mo. Sch. of Mines.

Proposed by Charles Y. Clayton, C. R. Forbes, G. H. Cox.

Born 1898, Raymond, Miss. 1915, Rayville High Sch. 1917, Mo. Sch. of Mines. 1919, Surveying wk.

**Leon Burr Schumacher**, Rolla, Mo.

Present position: Student, Mo. Sch. of Mines.

Proposed by C. R. Forbes, Charles Y. Clayton, A. L. McRae.

Born 1894, Sandusky, Ohio. St. Louis High Sch. 1916-19, Mo. Sch. of Mines. 1917-19, Instrumentman, Mo. Pacific R. R.

**Juan Enrique Serrano**, Golden, Colo.

Present position: Student, Colo. Sch. of Mines.

Proposed by J. C. Roberts, Lester S. Grant, J. A. Palmer.

Born 1896, Valparaiso, Chile, S. A. 1908-13, Colegio San Ignacio, Santiago, Chile. 1914, Catholic Univ., Santiago, C. E. & Univ. Chile, "Bachelor in Humanity." 1917, Colo. Sch. of Mines. 1918, summer, Sampler, timbering, Draftsman, Blistered Horn mine, Pitkin. 1919, summer, Ore Sorter, Liberty Bell Gold Min. Co., Telluride, Colo.

**Everett Louis Sheldon**, Houghton, Mich.

Present position: Student, Mich. College of Mines.

Proposed by J. B. Cunningham, F. W. Sperr, F. W. McNair.

Born 1897, Mount Clemens, Mich. 1911-15, Mount Clemens High School. 1916-17, Univ. of Mich. 1917-19, Mich. College of Mines.

**Benjamin Edward Sherman**, Rolla, Mo.

Present position: Student, Mo. Sch. of Mines.

Proposed by C. R. Forbes, Charles Y. Clayton, G. H. Cox.

Born 1898, Tahlequah, Okla. 1912-16, North Eastern State Normal Sch., Okla. 1916-18, Mo. Sch. of Mines.

**Thomas Adrian Stevens**, Rolla, Mo.

Present position: Student, Mo. Sch. of Mines.

Proposed by M. H. Thornberry, A. L. McRae, M. E. Wilson.

Born 1896, Caney, Kans. 1917-19, Mo. Sch. of Mines. 1915-17, Asst. Chem., 1917, Chem., Amer. Zinc Lead & Smelt. Co., Caney, Kans. 1918-19, Sta. Asst. Min. Exp. Sta., Mo. Sch. of Mines.

**Mark Taynton**, Madison, Wis.

Present position: Student, Univ. of Wis.

Proposed by Richard S. McCaffery, E. R. Shorey, W. J. Mead.

Born 1897, Berkeley, Calif. 1917-19, Univ. of Wis.

**Rafael Esteban Velasco**, Rolla, Mo.

Present position: Student, Mo. School of Mines.

Proposed by Charles Y. Clayton, M. H. Thornberry, A. L. McRae.

Born 1891, Cadral, S. P. P., Mexico. 1903-06, Inst. Cient y Lit. 1909-13, Mt. Hermon School, Mt. Hermon, Mass. 1913-17, Mo. School of Mines. 1907-09, Bonded Clerk, N. Y. Life Ins. Co. 1916-17, Office of Constr. Engr., Anglo-Mexico Pet. Co., Tampico, Mexico. 1917, Fire Assayer, A. S. & R. Co., Aguascalientes, Mexico. 1917-19, Asst. Chem., Cia Met. Mexicana, S. L. P., Mexico.

### *Change of Status—Junior Associate to Member*

**Nelson Burnes Gatch**, New York, N. Y.

Present position: Mgr. of Sales, N. Y. Dist., Chicago Pneumatic Tool Co.

Proposed by James A. Caselton, Philip N. Moore, Arthur Thacher.

Born 1888, St. Joseph, Mo. 1908-11, Columbia College. 1911-13, Columbia School of Mines, B. S. & E. M. 1913-14, Min. Engr. 1914-16, Gen'l Supt., Granby Min. & Smelt. Co. 1916-18, Vice-pres. & Gen'l Mgr., Miami Zinc Co. 1918-19, Capt., Air Service, U. S. A.

**Chester Mahlon Knepper**, Bethlehem, Pa.

Present position—1917 to date: Inspector of Eng. Material, Bethlehem Steel Wks.

Proposed by C. A. Buck, E. G. Grace, H. Merryweather.

Born 1861, Somerset, Pa. 1880-84, U. S. Naval Academy. 1915-17, Colo. Sch. of Mines, E. M. 1907-10, Charge of armor, Bureau of Ordn., Navy Dept., Washington, D. C. 1880-1919, Cadet & Commissioned Officer, U. S. Navy, active list to 1913.

**Leroy Robert Scheurer**, Wichita Falls, Tex.

Present position: Working for self.

Proposed by A. L. McRae, M. H. Thornberry, G. H. Cox.

Born 1893, Nashville, Ill. 1909-12, Wichita Falls High Sch. 1912-17, Mo. Sch. of Mines and Met., B. S. 1913, Mucker, Storekeeper and Service Boss, Buffalo Mine, Ltd., Cobalt, Ont., Canada. 1915, Sampler, Ajo Cons. Copper Co., Ajo, Ariz. 1915-16, Chemist, Assayer & Engr., P. A. Min. & Mill. Co., Pinos Altos, N. Mex. 1916, Engr., Chino Copper Co., Hurley, N. Mex. 1917, Sampler, Arizona Copper Co., Morenci, Ariz.; Office and Library Asst., Mo. Sch. of Mines, Rolla, Mo.; Instrumentman, Mo. Bureau Geol. & Mines. 1918-19, Prof. of Min., No. Georgia Agri. College, Dahlonega, Ga.

## ONE OF FRANCE'S RECONSTRUCTION PROBLEMS

One of the problems confronting the Minister of Mines of France, and one on which he is asking assistance, is to obtain some method of ascertaining the condition of the casings of shafts under water. The plants are destroyed completely and the shafts are full of water. From one shaft the water was running out at the top in a stream of 2000 or 3000 gal. per min. This shaft seemed filled with débris, and many dead men had been thrown into it.

The conditions are as follows: Surface, about 60 m. of porous material—like an underground river or lake. Clay 30 m., impervious to water. The shafts are steel-lined through the porous water-bearing strata, and cemented in and made water-tight—below the clay there is little or no water. The Germans blasted out the steel linings in a great many shafts, allowing the water from above the clay to get down into the mines. As the shafts are now all full of water, it is important to know which shafts have the "cuvellage" intact, or otherwise. The amount of water to raise is about 200,000 cu. m. (or tons) per day.

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## Federal Taxation of Mines

BY L. C. GRATON, WASHINGTON, D. C.

(Chicago Meeting, September, 1919)

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### SUMMARY

THE Federal taxes on incomes and excess profits are of course heavy. In 1917, the value of the mineral production of the United States was a little in excess of \$5,000,000,000. The total of Federal taxes for that year, for the mineral producing companies, as computed by themselves, amounts, according to tentative compilations, to about \$207,000,000, and the total for the comprehensive group of mineral and metal industries to about \$766,000,000, which figures represent respectively 9.5 per cent. and 35.1 per cent. of the total tax paid by all corporations. Because of greater complexities in applying the revenue laws to mineral properties than to most other industries, opportunity is afforded for wide differences of view. The taxes indicated above, therefore, are not final

and may conceivably be very materially increased. For 1918, the taxes are expected to be still greater, but no compilations are yet available. Taxes at a high rate are to continue indefinitely. The subject is clearly of gravest import to the mining industry in particular.

The Commissioner of Internal Revenue, who is charged by law with the administration and collection of the taxes, is determined that these functions shall be performed in a just and businesslike way. Fairness and finality are to be the chief objectives.

In view of the peculiar conditions that attach to the tax program as applied to mines and other wasting industries, like oil, gas and timber, the Commissioner has resorted to professional advice and assistance by manning a Sub-division of Natural Resources with competent engineers, brought in from the several industries, into whose hands he has placed for solution the technical questions involved.

These engineers have a two-fold duty: (1) to devote to the solution of these problems their own knowledge and experience; (2) through their acquaintance with their respective industries, and with the men engaged in those industries, to focus upon these problems, by conferences and otherwise, the best opinion of the country. The principal object of this paper is to acquaint the mining profession with the attitude of the Revenue Bureau and to enlist to the fullest possible extent its interest and professional coöperation.

Attack upon the problems of mine taxation must necessarily start from a clear understanding of mining economics, of which the prominent and distinctive features are hazard and exhaustible character of assets. Closely related to this last feature is the necessity of maintaining efficient mining organizations indefinitely instead of limiting their existence to the life of the particular mine now being worked.

The principal questions to be settled revolve about the matter of mine valuation, but they are complicated by the fact that the most of the values must be established as of a date several years ago. Among a variety of valuation methods that might be employed, the one direct, professional, and established method is that which capitalizes income by determining the present value of total expected earnings.

For the general application of this present-value method, there must be established a set of factors intended to adjust it to those examples which afford less data than the amount it requires ideally. Investigations must be conducted with more or less detail and thoroughness into a variety of subjects which enter into the application of the method, such as relation of interest rates to hazard, ratio of proved to prospective ore in various types of deposits, effect of change in grade of ore and in rate of output, estimate of future production cost and selling price of product, what constitutes discovery of a mine, and methods of depletion and depreciation.

In the determination of all these matters closest touch with the industry will be maintained, with the sole idea of establishing principles that will be so sensible and sound that they may apply not only to the final settlement of taxes for the years now under review but may govern likewise through subsequent years so long as present or similar revenue laws prevail. In this way, it is hoped that the suspense and confusion that now beset the mining industry because of the uncertainty pervading the taxation atmosphere may be materially alleviated if not wholly removed.

Sympathetic coöperation on the part of the industry is absolutely essential to the attainment of this object.

## INTRODUCTION

### *Proper Relation Between Taxpayer and Government*

At the outset of the discussion of so difficult and critical a subject as the fair taxation of our mines by the Federal Government, it may be well to put into words certain fundamental and axiomatic truths as a basis for further discussion and argument. Several of these facts are true independently, others are consequences of some that precede.

1. Government, according to modern conceptions, is no longer to be regarded as deriving its supreme and sovereign authority from some external and fictitious source, such as is implied in the phrase, "The divine right of kings." Modern government is merely an organization of society for the conduct of the functions and the life of the people in a more effective, just, and satisfactory manner than would be possible by the independent effort of individuals.

2. What we call "the Government," meaning the specific machinery and personnel of government, is thus in fact a servant which society engages for the performance of certain of its work.

3. Taxes are funds which society puts at the disposal of its servant for the accomplishment of the needed work.

4. The fundamental object of taxation is, therefore, not to impose a burden or a penalty on the taxpayer. Rather quite the opposite. The sole object of taxation is to secure the funds by means of which the government may be enabled to extend to the taxpayer those benefits which he could not so well, if at all, secure for himself.

5. Consequently, any taxation program should be administered with the utmost sympathy and consideration and with the least possible disturbance of the taxpayer's normal activities. Justification for deviation from such a sympathetic and coöperative attitude can arise only in case the taxpayer shows unwillingness to carry through his part of the arrangement. An attitude of arrogance or of suspicion adopted at the outset by the tax-collecting agency toward the taxpayer would be as much out

of place as in the case of an ordinary employee toward his employer; and such a policy would inevitably kill that spirit of coöperation which certainly ought to prevail if for no other reason than to secure the best results most easily and simply and continuously.

6. It goes without saying, on the other hand, of course, that a tax levied by a law enacted by the agency which society has created and maintained is not something to be dreaded or evaded. The payment of a tax should carry with it a very genuine conviction on the part of the taxpayer that it is for value received and should be regarded in the same way as the rent bill, the meat bill, or the wages of the cook, none of which the sensible and fair man will either begrudge or endeavor to escape, but on the contrary will ascertain to be correctly and fairly computed and will then pay promptly and fully.

7. Finally, rather for the sake of completeness than because reference to the matter is necessary, let it be added that the tax-collecting agency, charged as it is with the heavy responsibility to the society that is its creator and master, must act with decision and firmness at all times, and in any case of evident and deliberate transgression of the spirit of the tax obligation must unhesitatingly resort to use of the authority with which it is empowered.

### *Object and Scope of Paper*

It is my purpose to address you, not only as an employee of the Internal Revenue Bureau, which is charged with assessment and collection of the Federal taxes, but also as a member of this Institute, as one whose normal activities are confined to the mining industry and whose fundamental interest is in its welfare, but who, mainly by chance and for a very short time, has had an opportunity from the inside to come in contact with the tax-collecting organization and thus to see and learn a number of things in which many of you are likely to be interested but with which, perhaps, not all of you have had occasion to become fully acquainted. I wish, therefore, to discuss with you in entire frankness, as one engineer to a group of engineers, the problems involved in the application of the present tax laws to the mining industry and the best methods by which those problems may be solved. I cannot emphasize too strongly, and I trust you will bear definitely in mind throughout, that my remarks reflect personal, not official opinions, that they may be possibly suggestive but certainly are not authoritative.

I am not sent here as a propagandist for the Government. The idea that this subject should be presented before you arose from a recognition of the magnitude of the task and from a realization of the assistance that might be gained from such an organization as this Institute. A few weeks ago, I proposed the idea to the Head of the Income Tax Unit, who readily gave assent and approval to the suggestion.

Furthermore, you should know that this outline of the situation with regard to mine taxation is presented by me rather than by someone of greater experience and authority both in general and in the specific problems of mine taxation only for these two reasons; because no time ought to be lost in initiating a spirit of coöperation between the Government and the mining taxpayer, and because in the building up of that part of the Revenue Bureau's organization which will deal with the specific problems relating to mines, it has happened that, until a few weeks ago, I was the only representative of the mining industry proper, though oil and gas and timber are already pretty well provided for. In the consideration of the topics presented in this paper, I have derived much benefit from discussions with two of my colleagues in the Bureau, Mr. J. C. Dick and Mr. J. H. Hance, valuation engineers in the Mining and the Oil Sections, respectively. This paper has been somewhat revised since its presentation at the Chicago meeting in order to place in connected relation to its main structure certain ideas suggested by the discussions of others; reference to the source of these ideas is made by footnotes.

The purpose of this paper is essentially twofold: First, to bring what I trust may be regarded as good news; second, to invoke from you such coöperation, advice and assistance as can come from no other group of men in so full a measure or so authoritative a fashion.

### *Attitude of the Revenue Bureau*

Until very recently, the Internal Revenue Bureau has been a relatively subordinate branch of the Government, and has had little attention from the average citizen. Since the passage of the income-tax amendment in 1913, however, and particularly since the rise of needs for enormous war funds, the Revenue Bureau has become, as the Commissioner has said, "an arm of the Government reaching out to every citizen and establishing a direct fiscal relationship with every business enterprise in the United States." An inevitable consequence of this tremendous increase in prominence and power and responsibility has been a growth and improvement in point of view and in methods held and practised by the Bureau, and I think it but fair to say has brought about, directly or indirectly, a higher type and average of personnel in positions of responsibility.

As all are aware, the revenue laws in so far as they specifically touch on the matters which relate to the mining industry are nearly always brief and frequently not superlatively clear. These, like all other portions of the revenue laws, are made subject for their interpretation and application to regulations to be established by the Commissioner of Internal Revenue. It is most illuminating to observe how, as the importance and responsibility of the Commissioner's duties in this respect have expanded

with the increasing magnitude of the taxes, the regulations with regard to the mining provisions of the law have with successive years reflected a greater and greater approach toward that two-sided fairness and equity which alone can be satisfactory and can lead to decisions and settlements that will hold with finality. It is true that of the older points of view and the past methods some that are imperfect still survive in the interior structure of the tax-collecting machine, but I assure you very confidently that Mr. Roper, the present Commissioner, and Mr. Callan, who, next to the Commissioner, is in charge of the entire income-tax administration, are thoroughly imbued with the desire and the determination to administer the taxation program in an absolutely fair and businesslike way. In substantiation of what I have just said, may I quote from the last annual report of Commissioner Roper, dated Oct. 15, 1918. In the concluding sentences, he said:

An open-minded attitude must be maintained in the interpretation of the law, in the framing of regulations, and in the application of the law and the regulations to particular circumstances. Administration must be even-handed and impartial; the objective must always be to secure resolutely the full observance of the law, protecting equally the interest of the taxpayer and the Government. \* \* \* With the conviction that this policy will be met halfway by the people, the Bureau approaches with confidence the task of administering the pending revenue bill, which contemplates the collection during the current fiscal year of double the amount of taxes collected during the fiscal year 1918.

In further proof that this policy is actually being carried out in the intended spirit, you will be interested to know of a general order to revenue agents recently issued by Mr. Callan, head of the income-tax administration, which directs that no rating of employees for purposes of promotion shall be based on amount of additional taxes they recommend but solely on capacity, efficiency, and dependability.

Finally, coming closer to the matter of our own interests, I trust you will permit me to express the opinion that the recent establishment in the Revenue Bureau of the Sub-division of Natural Resources, whose business it is to give expert recommendation and to take final action in the formulation of guiding principles and in the actual settlement of questions relating to taxation of the mineral deposits, the timber lands, and other natural resources, is in itself an index of the conceptions and the motives of the Bureau. And when I tell you that effort has been made to bring into that division able and experienced engineers into whose hands the solution of these problems shall be placed without reservation or qualification, save such as the law imposes, and that every man in the organization from top to bottom is engaged and retained without the slightest influence of political expediency, I believe you will agree with me that there is much justification for believing that the general ideals or axioms I mentioned at the very outset are to be made the aim of the tax admin-

istration and that so far as the special matter of mine taxation is concerned, there is good reason for hoping that this admittedly difficult subject may be handled sensibly, fairly, and conclusively. Specific instances may continue, though I trust with constantly decreasing frequency, to come to your attention which may seem to contradict what I have endeavored to establish. I beg of you to believe, however, that every earnest effort is being made to eradicate and abandon all those things which have caused confusion, exasperation, or alarm to the honest and well-intentioned taxpayer.

### *Assistance and Coöperation of the Industry Needed*

With this part of the story, which is really introductory, I have occupied so much of your time for the reason that to bear this message from the inside is a foremost object, perhaps indeed the principal object, of this paper. It is, moreover, a necessary preliminary to the successful attainment of the second object, which is the securing of your coöperation and your help in solving a job which is as much yours as the Government's and which is no more to its advantage than to yours to have solved correctly. For notwithstanding every reasonable effort which the Government may make, the job that confronts us is so big and difficult, has so many ramifications and complications, that I believe the Government cannot master it single-handed, but must look to the specialized groups of taxpayers—in the case of mines, to the mine owners, mining engineers and geologists—for the advice and for the help with which to put the deal through.

The Government is in a frame of mind to trust you high-grade and reputable engineers, to trust not only your technical talents, but to trust also your motives and integrity; and you are invited and indeed urged to contribute, for the sake of the general welfare of the industry, such help as you can, by correspondence, by conferences with the Federal officials, and by discussion among yourselves and associates.

Any such policy of coöperation as this obviously necessitates that you shall be taken into the confidence of the Government, that you shall know what it is trying to do in order that you may suggest improvements and short cuts, may point out and correct mistakes, in a word, may have an effective and influential hand in the administration of the revenue laws as applied to your industry.

In what follows, therefore, while leaving numerous features quite untouched, I shall try to indicate, in merest outline, some of the principal problems involved, though most of you no doubt have by necessity become familiar with them through your professional connections. I shall also try to sketch briefly some of the methods of attack upon these problems which the Bureau is considering in a tentative way. These

problems and these tentative methods constitute the target toward which it is hoped that you and others like you may direct your criticism and your help.

## FUNDAMENTALS OF MINING ECONOMICS

### *Risk*

Since the subject of mine taxation cannot be approached intelligently without a thorough understanding of mining economics, we may well consider briefly some of the economic principles and factors which we all realize apply to the mining business.

The applications and relations of capital to the mining industry involve different principles and are on a different basis from those in other forms of enterprise or investment. Two essential factors serve to distinguish the economics of mining from the economics of other industries; first, the much greater risk generally involved, and, second, the fact that the life of the enterprise is fixed by conditions over which those engaged in it have but little control. If the hazards of mining could be brought down to the average level of other industrial undertakings and if the life of mines could be maintained indefinitely by application of a good average degree of intelligence and effort, mining would take its place on the same plane with the manufacture of clothing or the growing of wheat or the running of a hotel. As a matter of fact, however, neither of these things can be brought about; in consequence, it is necessary to consider mining as something different from a business in the ordinary sense and in a class apart from most other undertakings. For the mine operator not only shares the risks common to other types of enterprise, such as the uncertainties of labor and the fluctuations of market, he has in addition to bear certain unique risks peculiar alone to mining and equaled in magnitude in few if any other industries.

In ordinary business, investment of capital results in the acquisition of something of inherent value which, in case of failure of the enterprise, can be disposed of at a price that will go part, or all, of the way toward refunding the capital invested. For example, suppose a company engages in the shoe business or the milk business and finds, after due trial, that its costs of production are such as not to afford commensurate profit on the capital invested. In short, it fails. It can dispose of its tangible holdings, which represent the largest portion of its investment—its leather and machinery and plant, in the case of the shoe business, or its cows and its lands in the case of the milk business—to successors who hope by better methods to turn failure into success. Even if a considerable loss is so involved, something at least is saved.

*Hazards of Ore Supply.*—But in mining the raw material represents the chief investment and the raw material is the ore. In general, the

success of the mining enterprise depends primarily on what nature has put into the ground. Over that no man has control and, ordinarily, no one may know what or how much until he spends much money to find out. And if one company's operations demonstrate that, in a given tract of ground, nature was not sufficiently generous to give man a profit, it would be difficult to persuade anyone else to purchase the property—the value is next to nothing. For a mass of ore in the ground is not like leather or machinery or cows; it has no inherent and intrinsic value; its only value lies in its capacity to produce profit when mined and treated—if it cannot do that, it has no value whatsoever. In such an instance as I have outlined, therefore, every dollar added by the company in development work makes the situation worse and actually reduces the value of the property by gradually eliminating the possibility that a better state of affairs may be disclosed. In short, each addition to capital account has the paradoxical effect of lessening capital value.

The great majority of mining ventures are of the kind just indicated. They fail to return investment plus a reasonable earning upon it. Most of them fail even to make a pretense of returning the original outlay. It has been said<sup>1</sup> that on the Comstock lode, out of several thousand locations into nearly every one of which more or less money and effort were put, less than fifty ever found sufficient ore to justify extensive development and still fewer ever paid dividends. Yet the gross product of bullion from the comparatively few active mines was enormous.

Though the hazards of ore supply are probably greatest in the prospect and early development stages, they are by no means absent in the later stages of a mine's history. Even when promising deposits of ore have been found, and perhaps extensively developed, unexpected geological conditions, such as faults, pinches, change in rock, or erratic distribution of values, far too often turn hoped for success into dismal failure. The Alaska Gastineau is a recent conspicuous example among many.

In short, ore supply, whether to convert a prospect into a mine, or to assure the continued operation of a going mine, is in the majority of instances a most fickle and unreliable thing and involves a degree of risk far beyond that of most industries.

*Hazards of Operation.*—Nor are the risks peculiar to mining limited to the question as to whether or not a given piece of ground will be found productive and worthy of the establishment upon it of an active operating mine, or whether the mine so established will continue to find profitable ore. The history of mining is literally filled with examples of important and temporarily profitable mines which gradually or suddenly come to grief in consequence of some of the accidents that constitute the other special hazards that peculiarly attach to the mining business.

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<sup>1</sup> R. H. Stretch: "Prospecting, Locating and Valuing Mines," 20. New York, 1909.

Finlay, who must be regarded as a conservative in the matter of mining investments, referred on the opening page of his well-known book,<sup>2</sup> to the Treadwell mine in Alaska as one of the really stable and valuable investment securities. In 1909, such a characterization was abundantly justified. Yet in 1917, the chief value of the largest part of the Treadwell mine, if it had any value whatever, was as an aquarium for salt-water fish. In 1905, the Atlantic mine in Michigan had the distinction of earning profit on the lowest grade of copper ore that had ever been treated, namely, but slightly over one-half of 1 per cent. yield. Yet, the very conditions which had made that enviable record possible, namely, the even and continuous mineralization of the lode with consequently high proportion of extraction to waste or pillars, was the very cause which in the following year led to the entire wrecking of the mine and the mine plant by caving, so that today, in spite of efforts made in the interval, the value of the property is essentially nil. Coal mines, flourishing today, are wrecked tomorrow by explosions of dust or gas. Mines in Pennsylvania, in Butte, in Jerome, in Shasta County have been on fire for years. Many a mine with good ore still in it had to be abandoned, perhaps after years of successful operations, because water at last gained the upper hand and now stands high in the shaft. Every mine faces one or another or several of these and other catastrophies. In some respects, the greater the mine, the greater the menace.

It may be urged that accidents to mines are often due to bad management and might have been avoided by men of proper experience and ability. To this contention the reply may be made that in mining, as in everything else, we determine what is sound practice only by contrast with what proves to be faulty and unsound; we make progress through avoiding previous mistakes; we do not dread the fire until we have been burned. Moreover, in mining, especially, experience accumulates slowly, partly because a long time is required for working out a large mine, and partly because the variations in conditions from mine to mine are so great that the conclusions indicated in one instance may prove (perhaps only after costly trial) to be quite inapplicable to another. But even if the contention of bad management be accepted, it is nevertheless true that in few other industries must so heavy a penalty for mismanagement be risked as the utter wrecking of the entire enterprise.

*Unusual Profits Represent Incentive and Insurance.*—Clearly enough if the industry is to survive at all, the abnormally high risk in mining must be offset by abnormally high returns in those instances which turn out profitably. These views of extent of risk and compensation for it are not confined to mining men, who might naturally be regarded as biased in their judgments. Such views have long been recognized and ex-

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<sup>2</sup> "Cost of Mining," New York, 1909.

pounded by professional economists who have no more prejudice in favor of mining than of any other industry or occupation. The case has been put by them like this. The immense majority of mining ventures are failures. A multitude of disappointments is relieved by occasional success. Were it not for the chance of great rewards, all the vitally necessary but mainly unremunerative work of exploration would not be undertaken. In contrast with nearly all other fields of endeavor, it is altogether unlikely that, on the whole, the gains in the successful mining ventures suffice to offset the losses in the unsuccessful. Under such conditions, a high return to the few fortunate ventures does not constitute a true surplus, and must be accepted without prejudice as a necessary and legitimate stimulus to efforts that inure to the benefit of society.

The argument is sometimes advanced that the great profits made by some individual mining companies should, in large part, be taken through taxation by the Government so that the people as a whole may participate in the benefits that the nation's soil and rocks afford. If such policy should be followed, however, there would go with the collection of these profits by the Government the moral and economic obligation to perform all that vast ratio of profitless exploration on most if not all of which depends continued discovery of profitable mines. It seems highly improbable that the Government would pursue such discouraging work with the vigor and persistence that characterizes individual effort when stimulated by the unfailing hope of hitting upon a bonanza. Yet if this obligation should be shirked, mining would certainly languish. The farmer who eats up his entire year's crop of grain without providing seed for the next year's crop will never repeat the operation.

Moreover, none of the great hazards peculiar to mining can be insured against. The manufacturer's plant can be insured against the elements, his stocks of raw material, his goods in process can likewise be covered by insurance. The orange grower can insure against frost or hail, the banker against defalcation. But up to date, no company exists which will write insurance that protects the mine owner against the unexpected exhaustion of his orebodies or against calamities which may bring upon the mine a termination of its operations. The only possible insurance against these risks in mining is comprehended in a correspondingly greater return upon capital which shall be sufficient to induce the operator to assume the risks and which in the long run will go toward balancing the actual losses. Mill, the economist, says:<sup>3</sup>

The gross profit of capital may be distinguished into three parts which are respectively the remuneration for risk, for trouble, and for the capital itself, and may be termed insurance, wages of superintendence, and interest. After making compensa-

<sup>3</sup> "Principles of Political Economy," 2, Chap. 23, 153. Edition of the Colonial Press, New York, 1899.

tion for risk, that is after covering the average losses to which capital is exposed either by the general circumstances of society or by hazards of the particular employment, there remains a surplus, which partly goes to repay the owner of the capital for his abstinence, and partly the employer of it for his time and trouble.

In other words, by those who invest in the mining industry it must be recognized that compensation for hazard is to be provided for, at least in a mental way, before the true net profit of the enterprise is revealed. Clearly enough, the greater the hazard, the greater the portion of gross profit required to balance it.

*Increase in Mine Values not Unearned Increment.*—One of the effects of the hazards of mining is shown in the prices paid for prospects and partly developed mines.

There is a disposition among many people to regard as dangerous and vicious that type of property appreciation which is often designated by the term unearned increment. This view finds frequent reflection in a variety of ways in the tax laws of various countries, states, or communities. Without going into a discussion of the ethics or economics of this question, it may be admitted that there are certain justifications for penalizing, through the medium of taxes, those who bought land in the past and now, without any risk or effort on their part in the meantime, reap a disproportionate benefit either from its earning power or its sale. Since such people take for themselves a surplus which has come into existence only through the presence or the activities of the community or of society in general, it may truly be said that this appreciation is unearned by the beneficiary.

In order that the contrast with increase in mine values may be clearly disclosed, let us set up two imaginary cases. First, let us assume that A bought a large corner lot in a country town 30 years ago for \$1000.<sup>4</sup> If that price was reasonable and fair at that time, the buyer incurred practically no risk. No one could run away with his lot, it couldn't burn up or cave in. Land values the civilized world over, and especially in this country, where the increase in population had been so persistent and so great, had been steadily increasing and would doubtless so continue; only in exceptional localities were declines registered and these probably for the most part but temporary. All A had to do was to sit tight. It was through no effort or design of his that at some later date a railroad was constructed through the town, that the locality was found advantageous for the establishment of certain important industries, and that in consequence of the great increase in population A now sells his corner lot, in identically the same condition as at first, for \$100,000 as a site for a department store. One might say that the \$99,000 surplus was a result of A's foresight; just as likely, however, his retention of the

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<sup>4</sup> Suggested by discussion of Mr. W. O. Hotchkiss.

original purchase was a consequence of inertia or of outright good luck. But in any event, he gained the profit virtually without effort or risk.

Now let us turn to the case of B who bought, likewise 30 years ago for \$1000, a tract of what he hoped and believed would prove to be mineral bearing land. What would happen to him if he, like A, simply held on and did nothing? Even though profitable mines might develop all around him, and thus possibly cause an appreciation in the value of this tract, such appreciation would be only speculative. And as a matter of fact, few mines increase in value to any material extent through the non-activity of their owners. What B would almost certainly do would be, after paying \$1000 for the land, to spend a lot more money, plus much effort and time and anxiety, in sinking or tunneling to find ore. Labor, machinery, explosives, timber, building of houses and roads—these and other things have to be provided for, and isolation, privation, and hardship perhaps endured. A sum equal to the original \$1000 investment makes hardly a beginning; \$10,000 melts away before he knows where it has gone—provided he does not “go broke” before he gets that far. An encouraging development here, a flattering indication there, keep him going until his optimism outlasts his pocketbook and his ability to borrow—then he has to stop. Or perhaps, being endowed with a more conservative enthusiasm and greater resources he decides, after what he deems fair trial, that the property will not develop into a profitable mine. Under such circumstances he is more likely to have to abandon it outright or dispose of it for a pittance than to be able to sell it for anything reasonably approaching the stake he has put into it. With some remaining resources and with confidence probably undiminished (for only a confirmed optimist enters such a game) he buys another undeveloped tract for \$1000 and begins the cycle all over again.

It may be a matter of opinion how many times such a cycle has to be repeated before a property is found that can be converted into a real mine; that is, a commercially profitable source of metal or other mineral product. But there can be no doubt that on the average the number is very great. The large exploration companies are offered literally hundreds of properties in various stages of development for each one that they take up. I am informed by a strong American mining company operating in the Andes, where the opportunities for mine finding are supposed to be better than in this country, that they investigated 143 properties and found only one that was good enough to buy.

It really makes no difference whether B has sufficient capital to survive through the many failures to the time when one of the properties makes good, or whether he reaches the end of his resources and withdraws from the game, defeated, to be succeeded by some one else. The essential fact is that a successful mine is built on a long string of previous unavoidable failures. Of course, there may be individual excep-

tions. A newcomer may draw a prize on his very first venture, but the next man may draw twice as many blanks as the general average. Of course it is the average that counts; and on the average the chances that a given prospect will become a profitable mine are only one to scores and scores—say 1 to 50, 1 to 100, or what you will, but certainly something of that magnitude for mines of the precious and semi-precious metals. For iron mines the ratio averages somewhat lower, and for coal mines of course, lower still, but in all cases the principle is the same.

Let us assume that B persists until he finds a real mine, which then he sells for \$100,000. Is his \$99,000 increase on the same footing as that gained by A with the corner lot? Obviously not. First because B had to spend much in development work, perhaps \$20,000 or \$50,000, to reveal the \$100,000 value; and, second, because to find this one mine he had sunk \$1000 plus the \$20,000 or \$50,000 time upon time in previous prospects that at the outset may have looked just as good as the final successful one, but proved to be failures. Yet each failure contributed to the final issue by yielding experience at least.

A's surplus of \$99,000 was not earned; no surplus existed inherently in the property when he bought it, since his original purchase price paid fully for all the property eventually proved to be or to contain; no surplus was created by his efforts. On the other hand, the \$99,000 received by B may represent no true surplus or profit at all—instead an actual deficit may be involved. But by whatever name B's \$99,000 may be designated, there can be no doubt but that it is on a different footing from the gain realized by A. For the \$100,000 received by B is to pay for ore that was always present in the property, that was always a part of the property. B's efforts and expenditures have merely revealed the true value that the property had at the beginning.

Of course it is wasted breath to tell such things to mining men. But since these are facts which others should know, it may be permissible to clinch them with one or two analogies familiar to everyone.

Suppose a new battleship goes to sea to try her big guns at target practice. The explosive and projectile for each shot cost \$250. Assume the Navy average for vessels of that class is nine shots to one hit, and that our particular ship sustains that average. Here on the deck lay nine projectiles; one will hit the target, yet no one can tell which one, for they all look alike. The nine shots are fired; one hits; that one represents an expense of \$250, yet it really cost \$2250 to hit the target once. A prize of \$1500, offered by the company that built the ship, if the crew would equal the Navy average of one hit in nine shots, might seem to yield a handsome return if one thinks only of the single shot that reaches the mark; but in reality, the prize, instead of affording a surplus, leaves a deficit.

Or, to take another example, a man in the egg business maintains his

flock of hens by yearly additions from incubation. He buys fertile eggs, secures a hatch of 80 per cent., raises say 50 per cent. of these through the perils and vicissitudes of infancy, discards the half that prove to be cockerels and winds up with one effective pullet for each five eggs purchased. Plainly enough the one pullet came from only one egg, yet there was no escape from wasting the four others to secure the one pullet. There were no distinctive markings on the one egg that would finally yield the mature hen; it looked just like the other four. If pullets were worth \$1 each, and disregarding the cost of incubation and raising, he could not pay more than 20 cents each for the eggs for incubation.

It is the same with mines. An individual or a company that buys a prospect or a tract of ground which later develops into a profitable mine obviously can pay for it at the outset only such fraction of its eventual value as is represented by its chance of making good, that is, by its risk factor. The complement of this fraction is represented by the investments of the same owner or by others sunk in those prospects which failed to make good. These failures, like the four eggs, are an inseparable and absolutely necessary part of the transaction, they must be paid for and they must be charged against those few which turn out successfully.

As a final illustration, the prospect or little-developed mine may be compared with a herd of cattle on a range. The owner may estimate that he has about 2000 head. A prospective buyer rides over the range, concludes, likewise, that there are probably about 2000 cattle in the herd; the two men compare estimates, find that they agree, and effect a sale on that basis. If later, on actual count, it develops that there were 2100 or 1900 cattle in the herd, must the new owner refund the excess in the one case, or can he collect for the deficit in the other? Of course not. He bought the herd, so the herd is his. Likewise, when B bought the mineral land for \$1000, his deed gave him title to all the ore the land contained, irrespective of whether or not its quantity and grade were fully evident at the time. When, by development of the property, the actual count is taken, it simply measures and establishes the true value of what he bought at first.

### *Exhaustible Capital Value*

It has also long been recognized by economists as well as by mine owners and mining engineers, though not by everyone, that mining is an industry of wasting assets and that the apparent income for a given year's operations is not true profit but part profit and part return of capital. The miner who sells his metal or his coal is selling not only his product, he is selling at the same time a part of his mine. The price he receives per pound or per ton must cover both. Failure to appreciate fully this situation has led to illogical and foolish action by many people whether mine operators or investors in the shares of mining companies. It is to be

hoped that the general attention to this subject which the present heavy tax burdens are going to force, will greatly clarify the general understanding of it and will lead to a more sane and satisfactory basis for the conduct of the mining industry.

The entire conception, which some have seemed to feel is a complex and mysterious affair, becomes of utmost simplicity when the ore deposit is regarded merely as a great supply of raw material, the cost of which, along with the other costs, must inevitably be covered by the selling price of the finished product. Provision for this is made under the term "depletion," which, recognizing that ore, when once extracted from a mine, can never be replaced, aims to compensate for the inroads into the value of the mine thus occasioned by affording the money equivalent of the value, in the ground, of the ore removed. Thus at any time, value of ore remaining plus the depletion fund accumulated to date should equal a constant, which represents the value in the mine of all the ore originally estimated to be present. As is well known and will be discussed on a later page, the value of ore in the ground is the present value of the profit which that ore will yield when it shall be mined and treated. The true measure of depletion, therefore, is a function of the profit concealed in the ore. The subject of depletion is so well understood by professional mining engineers that further elaboration here would be quite redundant.

### *Mining Must Be a Continuing Industry*

In emphasizing the idea of wasting assets, Finlay has stated that a mine is exactly like an account in a bank whose business is being wound up by a receiver. Hoover, Smyth, and others have implied, likewise, that the business of a mining company is to work out its mine as rapidly as it reasonably can. Even more fundamental, however, than the conceptions which underlie these statements and in a sense contradictory to them, is a principle which is becoming more obvious and important each year, namely, that the business of a mining company should be the mining business, in just the same sense that the business of a railroad company is the railroad business.

What I mean is this: The companies which are producing the largest part of the country's output of most of the metals have made enormous outlays in time, effort, intelligence, and money to build up organizations of great size and remarkable efficiency, which cover all steps from the ore in the ground to the finished metal. In large measure, it is because of the perfection and the efficiency of organizations like these, some of them great, others on the way to become great, that the world is buying its metal supplies at prices not greater than those which now prevail. Probably in even larger measure is the country's dominance in mineral

production due as much to these highly perfected organizations as it is to the natural mineral wealth of the nation. This is demonstrated by the fact that Mexico, Chile, Peru, Russia, and other countries richly endowed with mineral resources made little utilization of them, when measured by modern standards, until American capital, enterprise and skill, singly or in combination—in a word, American ability for organization—took hold. To assume or to require that each of these great organizations must be torn down and thrown away when the particular lot of raw material, namely, the mine on which that particular company is operating, happens to be used up, not only would be rank folly, but would constitute an economic waste as direct and as deeply injurious to the public welfare as waste in the mining of coal, or in the efficient utilization of water power, or any of the other national extravagances or deficiencies which we are striving to overcome and eradicate. Evidences are constantly multiplying that large mining corporations realize that they must regard themselves as continuing organizations. They are providing, or attempting to provide, themselves with new supplies of raw material, that is, new mines to be worked up as soon as or before their present supplies give out. Since such a policy is sound and in accordance with public good, it must be both permitted and encouraged.

The policy of continuing enterprise is taken for granted in most industries. The shoe manufacturer, for instance, buys a six or twelve months' supply of leather. Out of the gross proceeds derived from working up this leather, he puts aside, as a matter of course, a sufficient amount to enable him, when that supply is exhausted, to purchase the next lot. Simply because the supply of raw material for a mining enterprise must of necessity be purchased in very large quantities which often suffice for many years, it is no less logical and fair that the mining companies ought, and should be permitted, to set aside out of the gross income from operations upon that lot of ore, a fund with which to purchase the next great lot. The only essential difference between the two illustrations is that in the case of the shoe manufacturer he can be practically certain that when his present supply is exhausted he can buy as much as he needs of a new supply without any doubt or risk and without any serious effort to locate it and at not very great difference in price. But the mining company, to replace its old mine, may have to spend much time and effort and anxiety in finding another and may have to pay far more per unit for the new one than it paid for its former supply which was purchased, perhaps, 10, 20 or 30 years ago.

Although timber comes under the head of wasting assets, the analogy with mineral deposits quickly ceases, for any given lot of timber increases in value through growth (less fire loss, which can be minimized by fire protection measures) and there is always the possibility of reforestation, either natural or artificial. Mineral deposits, however, are of fixed and

determined magnitude (in so far as concerns human utilization) and when once gone are gone forever.

Perhaps the closest analogy to the wasting assets of a mine is afforded by a farm which, after having been worked for a number of years without fertilization, begins to lose fertility through impoverishment of the phosphate and potash of its soil. Artificial fertilizer is then applied to replenish or replace those exhausted elements and the farm resumes its former productivity. Assume that the land originally cost \$1 per acre. That figure has absolutely nothing to do with determining the cost of fertilization now, which may be \$1 or \$2 per acre. Then, due to increasing demand for potash and phosphate for fertilizer use, the cost may mount to, say, \$5 per acre. But this may be justified by the increased yield. Surely, no sensible farmer would fail to charge the item of fertilizer expense into current cost of production of his crops, and no one could criticize his logic and his right in so doing. What he would be doing is providing for replacement of exhausting mineral constituents of the ground.

Then why should the miner not make similar financial provision for replacement of his great, long time purchase of ore, his mine, which he is in process of exhausting. In short, I believe that before long mining companies will set up a fund, not merely to return initial capital, not merely to refund the original cost of the current great stock of raw material purchased years ago, but a replacement fund—a fund which will truly fulfil the spirit of the sinking fund idea by making sure that the company constantly and fully maintains its power. This replacement fund ought to be large enough to include an insurance factor to cover the extra risk involved in assuring to the company its new supply of raw material.

If the average life of a successful mine is say 30 years, and if the cost of finding and securing such a mine doubles every 30 years, which is, I believe, a conservative assumption, it is easy to see how the policy of refunding only original investment will inevitably carry a company from a position of independence and power into a position of insignificance and impotency.

Moreover, the establishment and retention of a replacement fund by the active and reputable mining companies is the best remedy for what, in my opinion, is the present unsound and improper policy of doing business on borrowed money. As the tendency toward Federal regulation of private enterprise continues and grows, as it almost inevitably must, I believe industries will be obliged to support themselves mainly out of their own revenues, instead of invoking that overworked and, to my mind, eventually fallacious notion of depending so largely upon credit.

It must not be concluded, from the fact that in the last 50 or 60 years many great mine discoveries have been made (California, Australia,

Transvaal for gold, Michigan, Montana, Arizona, Chile, for copper, etc.) that such discoveries may be counted on to continue either at a growing rate to keep pace with general growth in population, industry, consumption of staples, etc., or even at a fixed rate. For these reasons:

1. Mining, although an old occupation, is in its modern developments essentially a new industry, just as the varied applications of steam and electrical power are new industries, and for the reason that all industrial development and advance started on a wholly new curve of progress during the 19th century. Although it is dangerous to set any limitations to the capacity of human intelligence, it nevertheless seems fair to assume that the advance in scientific, industrial and general material progress in the last few scores of years, say in the last 100 years, and particularly in the last 40 or 50 years, has produced a break or jump in the curve, not only greater than at any previous time, but greater than will ever again be achieved. It is unnecessary to enlarge upon this. I believe brief reflection will convince anyone of the probable soundness of the assumption.

The result was no doubt emphasized and hastened by the exploration and settlement of a new continent inordinately rich in ores and other natural resources, coming at this critical time in industrial development. Coinciding also as it did with a period of revolutionary advances in transportation and communication, the effect was to stimulate prospecting in all corners of the world, and mining engineering became the most roving of professions.

What may be termed, then, the acceleration in understanding of material matters and in incentive to progress has attained a maximum in the past few decades, and, in consideration of the span of human history, has attained that maximum with almost unbelievable abruptness. Indeed, one may almost say that *all of a sudden*, civilization turned its attention to industrialism, involving the use of metals and minerals and, therefore, involving the search for metal and mineral deposits. No such sudden addition of attention to mine hunting can ever again be expected. Consequently, no future epoch of mine finding can ever hope to equal that of the three-score period of years beginning with 1849.

2. In many respects the saying that "the early bird catches the worm" is true for mine finding. Imagine 100 gold dollars scattered promiscuously through a large haystack. Someone who realizes the value of a dollar happens along, sees one of the gold pieces practically at the surface of the stack and is naturally impelled to search for more. In a few minutes, he may find as many as ten of the gold pieces which were near enough to the surface either to gleam through the thin covering above them or to be revealed by a relatively slight scratching of the surface. To find the next ten, however, may require hours of patient and diligent lifting and

sifting and search. And the last ten may elude discovery for what is relatively a long, long time.

What is true for bright gleaming gold pieces in a pile of hay 10 or 20 ft. in diameter is, plainly enough, immeasurably more true of generally dull, inconspicuous deposits of ore buried to depths of possibly hundreds or thousands of feet in solid rock, and scattered through a mountain range or a continent. In short, most of the mining regions now known were relatively easy to find. Moreover, in view of the intensity of prospecting to which near and remote corners of the world have been subjected, it is safe to assume that of the total number of orebodies easy to find, most have already been found. In any event, the finding of new orebodies is becoming more and more difficult. The time has passed when the old-time prospector, generally unenlightened and superstitious (though not to be despised nor his past accomplishments belittled) can, with the assurance of a grubstake, be relied upon to replace the mines that are being exhausted at such a rate as present enormous scales of production imply. Otherwise, there would not have come into existence in the last 10 or 15 years the great exploration companies who are endeavoring to utilize every available means for mine finding; yet even these, notwithstanding their resources, are by no means meeting with the degree of success that could be hoped for. In a comparatively short time, the question of finding the new supplies of ores to meet the world's needs is going to become pressing, if not acute. In a word, the next great purchases of raw material for the mining companies are going to cost far more than the supplies they are now using up.

Prolonged failure to take account of these underlying factors of risk, exhaustible assets, and necessity for continuing enterprise in the mining industry must inevitably force into existence one or the other of these outcomes, either that mining will languish because it cannot be accomplished with profit, or that the business of mining will be continually passing into new and inexperienced hands, who, because of their lack of experience, optimistically rush in where the experienced companies found it impossible longer to tread. Either of these consequences would be most unfortunate and serious.

## THE TAX LAWS AS APPLIED TO MINES

### *Importance of the Mining Industry*

It is of course unnecessary before an audience of mining engineers to emphasize the importance of the place held by the mining industry of this country, whether measured in money value of output, in relation to the country's other sources of wealth, or in terms of international power which possession of such vitally important resources has afforded the nation. But merely to fix in our minds in some approximately quanti-

tative way the magnitude of the mineral industries of the country, the following facts may be cited:

In 1917, the latest year for which data are available, the value of the mineral production of the country, as computed by the United States Geological Survey after eliminating duplications, amounted to \$5,011,000,000. This represents probably a larger portion of the estimated gross national income of \$68,000,000,000<sup>5</sup> for that year than was contributed by any other single industry save the railroads. Indeed the only reason why the income of the railroads somewhat exceeded that of the mineral industry is because, as the Director of the United States Geological Survey has recently pointed out,<sup>6</sup> the mines and smelters, oil wells and refineries, quarries and cement mills furnish to the railroads more than 4,000,000 tons of freight a day, or nearly twice as much as all other freight combined. The dominant or highly important position of the United States as a producer of most of the common and fundamental mineral products is too well known to require even tabulation. As for the effect of this, we need only contrast the present position of this country with that which it would occupy if it possessed only world-average quantities of coal and oil, iron, copper, and other vital metals—if it were in the same condition with respect to coal, iron, and copper that it is in regard to tin.

The 1917 mineral output is divided in round numbers as follows:

|                       |                 | PER CENT. |
|-----------------------|-----------------|-----------|
| Principal metals..... | \$2,059,000,000 | 41.1      |
| Coal.....             | 1,523,000,000   | 30.4      |
| Oil and gas.....      | 703,000,000     | 14.0      |
| Miscellaneous.....    | 726,000,000     | 14.5      |
| Total.....            | \$5,011,000,000 | 100.0     |

Thus metal and coal mining account for 71.5 per cent. of the total mineral production of the country.

### *Magnitude of the Tax on Mines*

As would be expected from the gross income of the mineral industry, the portion of the total Federal taxes which this composite industry bears is very high indeed. Comparative figures are set forth below for the calendar years 1916 and 1917. The latter, approximate as yet, have been kindly supplied by Mr. Edward White, head of the Statistical Division of the Income Tax Unit. All figures are given in round millions of dollars. In the case of mines and oil and gas wells, the figures taken directly from the returns of the companies themselves may reasonably be regarded in the aggregate as minimum figures.

<sup>5</sup> *The Annalist* (Jan. 6, 1919).

<sup>6</sup> "The Strategy of Minerals," 321. New York, 1919.

## TAXES PAID BY MINERAL INDUSTRIES

| Official Designation            | 1916         |                                    | 1917          |                                    |
|---------------------------------|--------------|------------------------------------|---------------|------------------------------------|
|                                 | Amount       | Per Cent. of Total Corporation Tax | Amount        | Per Cent. of Total Corporation Tax |
| Extraction of minerals.....     | \$16,000,000 | 9.2                                | \$207,000,000 | 9.5                                |
| Smelters and blast furnaces..   | 10,000,000   | 5.8                                | 126,000,000   | 5.8                                |
| Petroleum, refined.....         | 3,000,000    | 2.0                                | 24,000,000    | 1.1                                |
| Stone, clay, and glass products | 2,000,000    | 1.0                                | 16,000,000    | 0.7                                |
| Total.....                      | \$31,000,000 | 18.0                               | \$373,000,000 | 17.1                               |

## TAXES PAID BY METAL MANUFACTURING INDUSTRIES

|   | 1916         |                                    | 1917          |                                    |
|---|--------------|------------------------------------|---------------|------------------------------------|
|   | Amount       | Per Cent. of Total Corporation Tax | Amount        | Per Cent. of Total Corporation Tax |
| Iron, steel and non-ferrous metals..... | \$23,000,000 | 13.5                               | \$393,000,000 | 18.0                               |

## TAXES PAID BY ALL CORPORATIONS

| Industry or Group*                           | 1916          |                    | 1917            |                    |
|--|---------------|--------------------|-----------------|--------------------|
|  | Amount        | Per Cent. of Total | Amount          | Per Cent. of Total |
| Mineral and metal industries, as before..... | \$54,000,000  | 31.5               | \$766,000,000   | 35.1               |
| Business and finance.....                    | 20,000,000    | 11.4               | 444,000,000     | 20.4               |
| Agricultural products.....                   | 26,000,000    | 15.0               | 345,000,000     | 15.7               |
| Chemical industries.....                     | 10,000,000    | 6.0                | 123,000,000     | 5.7                |
| Transportation.....                          | 22,000,000    | 12.7               | 99,000,000      | 4.5                |
| Public utilities.....                        | 8,000,000     | 4.9                | 48,000,000      | 2.2                |
| All other corporations.....                  | 32,000,000    | 18.5               | 359,000,000     | 16.4               |
| Total corporation tax.....                   | \$172,000,000 | 100.0              | \$2,184,000,000 | 100.0              |

\* The grouping in this last table is my own, but I believe fairly represents the relations between the several industries.

*Outline of Tax Laws, 1909-1918*

Although the Federal tax laws of recent years, as they apply to mines, have not taken into account in any direct way the excessive risks

involved in mining, they have lately given some recognition to the second difference that characterizes mining, namely, that its assets are exhaustible. This recognition comes under the head now designated in the laws as "depletion." It may be advisable in this connection to outline very briefly the revenue laws of the past 10 years, touching on each only in its particular application to the mineral industry.

Although various taxes were levied by the Federal Government on mining companies and on mineral production during the Civil War, the first federal tax in recent years to affect the mining industry was the corporation excise tax of 1909, which was, to all intents and purposes, an income tax and was given its particular name simply to escape possible unconstitutionality of an income tax pure and simple. It levied a tax of 1 per cent. on the net income above \$5000. This law provided, as a deduction from gross income to arrive at taxable net income, "a reasonable allowance for depreciation of property, if any," but did not specifically refer to depletion of mineral deposits. Many mining companies, however, in making their returns under this law, made claims for depletion. The Internal Revenue Bureau allowed these claims, wholly or in part, until 1913 when the Supreme Court, in a much-discussed decision, held that depreciation as used in the law does not apply to exhaustion of mineral deposits and that, therefore, no deduction on account of such exhaustion could be allowed.

In 1913, however, after a special constitutional amendment, finally ratified on Mar. 1 of that year, had validated the principle of taxing incomes, the 1909 excise act was superseded by a new law. This levied a 1 per cent. tax on net income, which should be computed after deducting, among other things, "a reasonable allowance for the exhaustion, wear and tear of property, arising out of its use or employment in the business, not to exceed, in the case of mines, 5 per cent. of the gross value at the mine of the output for the year for which the computation is made." Thus the principles of both depreciation of physical property and depletion of mineral deposits were put upon a firm legal basis.

The 1913 revenue law was superseded, in 1916, by one which levied 2 per cent. on the net income of corporations and provided tax-exempt deductions as follows: "a reasonable allowance for the exhaustion, wear and tear of property arising out of its use or employment in the business or trade." In the matter of depletion, oil and gas wells were for the first time specifically distinguished from mines. The oil and gas wells were granted, "a reasonable allowance for actual reduction in flow and production," while to mines was given, "a reasonable allowance for depletion thereof not to exceed the market value in the mine of the product thereof which has been mined and sold during the year for which the return and computation are made."

The 1917 income tax law applied a 6 per cent. tax on corporation

incomes with exactly the same terms as to depreciation and depletion as did the 1916 law, but to meet the heavy additional expenses of war, there was also placed upon corporations a war excess-profits tax which levied from 20 per cent. to 60 per cent. on portions of the net income as determined in relation to invested capital. There was also inserted in the income-tax law of 1917 a provision that an additional 10 per cent. to 15 per cent. be levied on that portion of the year's income undistributed 6 months after the end of the year, except such parts of that surplus as are actually invested and employed in the business or are retained for employment in the reasonable requirements of the business or are invested in Liberty Bonds.

Finally, the revenue law of 1918 levies a 12 per cent. tax on corporation incomes for the year 1918 and 10 per cent. for subsequent years. In this law, depreciation is covered by "a reasonable allowance for the exhaustion, wear and tear of property used in the trade or business, including a reasonable allowance for obsolescence," while with respect to depletion, the law provides,

In the case of mines, oil and gas wells, other natural deposits, and timber, a reasonable allowance for depletion and for depreciation of improvements, according to the peculiar conditions in each case, based upon cost including cost of development not otherwise deducted; provided, That in the case of such properties acquired prior to Mar. 1, 1913, the fair market value of the property (or the taxpayer's interest therein) on that date shall be taken in lieu of cost up to that date; provided further, That in the case of mines, oil and gas wells, discovered by the taxpayer, on or after Mar. 1, 1913, and not acquired as the result of purchase of a proven tract or lease, where the fair market value of the property is materially disproportionate to the cost, the depletion allowance shall be based upon the fair market value of the property at the date of the discovery, or within 30 days thereafter.

There was also imposed a war-profits and excess-profits tax which provides for the collection on various fractions of the income of amounts that range in 1918 up to as much as 80 per cent. of certain portions, and up to 40 per cent. for subsequent years.

Summed up, therefore, these several laws have provided for taxation of income at steadily increasing rates from 1 per cent. up to 12 per cent. for 1918. They have levied heavy excess-profits tax in 1917 and still heavier in 1918. Both income and excess-profits taxes are continued indefinitely for years subsequent to 1918, though at rates somewhat lower than for 1918. Allowance for depreciation of physical property has been provided for in the income tax of each of these years and has been extended to cover obsolescence beginning with 1918. Depletion has been treated in a different way with nearly every law. Allowances for depletion, specifically unauthorized by the first law, were granted until pronounced illegal by the Supreme Court. Then, in 1913, a 5 per cent. allowance on the gross value of the year's product at the mine

was granted; in 1916 and 1917, an allowance not exceeding the market value of the year's product in the mine; and, in 1918, a reasonable allowance for depletion according to the peculiar conditions in each case, based generally upon market value as of Mar. 1, 1913, but allowing for revaluation in case actual discovery subsequent to that date shall have materially increased the value.

On the whole, therefore, increasing taxes have been accompanied by increasing reasonableness and liberality as to tax-free deductions for depreciation and depletion, though of course the increase in the allowances has been of no such magnitude as the great increase in taxes.

## ADMINISTRATION OF THE TAX LAWS

### *Survey of the Situation*

It is clear that whether the existing laws be reasonable or senseless, whether they be fair or unjust, whether they be mild or oppressive, the activities of the Revenue Bureau are necessarily confined to the limitations that the laws impose. If the laws are found to be bad, it is to be hoped that their shortcomings may be so clearly pointed out that Congress will see fit to remedy them for the future; but unless relief, if found to be needed, shall subsequently be given and made retroactive, which seems unlikely, the procedure which must be followed for the present is already outlined in the laws.

The country being at present committed to tax upon incomes, we are freed or prevented, as one may care to regard it, from considering whether the modern idea of determining tax by ability to pay rather than by amount of service rendered to the taxpayer by the Government is ethical and sound; and from trying to decide what methods of taxation are fairest. In the matter of mine taxation, for example, we cannot be materially concerned with policies for taxing idle mineral lands or unprofitable mines, since neither class earns income. All we have to do, all we can do, in the present connection is to take the laws as they are and try to apply them fairly.

The regulations which according to the laws are to be promulgated by the Commissioner of Internal Revenue for the interpretation and application of the tax laws have been written for each of the laws through 1918. But in their case, opportunity for revision and improvements is not excluded, for the desire and intention of the present Commissioner are, while adhering to the limits set by the law, to administer the tax program in the light of facts and equity. It is for the purpose of assisting in the formulation of rules and the making of decisions relating to minerals and related products that there has been gathered together a group of engi-

neers to constitute the recently established Sub-division of Natural Resources of the Income Tax Unit. These engineers are, therefore, to assist in revising the regulations relating to natural resources products for the years back through 1916, wherever necessary to bring them into accord with the true intent of the law and with the present policy of the Bureau.

Obviously enough, the main job of this Natural Resources Sub-division is one of valuation. Initial value and the decline in values resulting from time, wear, and exhaustion, fix the depreciation and depletion deductions; valuation is the essence of the test of discovery; actual value is the one true measure of invested capital.

The handling of the timber problems has been begun and is being carried out under very auspicious circumstances with a most cordial and effective relationship established between the Government and the forest industries. The oil and gas program, which has been under way for something like a year, is well advanced toward completion. The metal and coal-mining problems, however, have been but slightly touched as yet, in so far as concerns settlement of those features that depend upon valuation, for the determination of the taxes in 1917 and for the review of the taxes for 1916, although for the preparation of the questionnaire that has been sent to all mining companies and for some other preliminary work, the Bureau had for some months the assistance of Dr. R. C. Allen, whose experience with mine taxation in Michigan was a most valuable asset.

It is the plan to have 1917 and earlier years out of the way before undertaking 1918 cases, but the settlement of valuation principles and the rules for their application will be made once and for all as soon as possible; and when these objects shall have been accomplished and the 1917 cases settled, it is hoped that operations thereafter may become in considerable measure a matter of routine.

### *Point of View*

*Equity and Finality.*—Reverting to a topic already mentioned, may I outline again, this time a little more specifically, the point of view which it seems to me should guide a proper application of taxation laws to the mines.

The two fundamental objects to be achieved are, first, impartial balance as between different taxpayers in a given industry and as between one industry and another and, second, finality of the decisions. If proper balance is attained, finality will be assured. If, on the other hand, the decisions are not sensible and just, there is likely to be no end of revision and unsettling of results, so, after all, balance is the prime requisite. The Revenue Bureau will endeavor to act in the joint capacity of trustee for the taxpayer and for the Government and will seek to harmonize the

interest of each. It will try to be equally as eager and prompt in refunding tax that may have been collected in excess of what is properly due as in collecting all that ought to be paid.

The latest law clearly recognizes the wasting industries. The mining industry is thus among the few to which distinctive treatment of any kind is applied. The idea has gained hold in the minds of some engaged in other industries that mines are thus accorded special favors or advantages. This view, however, is entirely erroneous. For while certain allowances are made because of the exhaustible character of mining assets, they are only such as fairly provide for including cost of raw material in total cost of production, and serve only to remove what, in their absence, would be a harsh and unfair discrimination against mines and other wasting industries. Moreover, not all the consequences of the exhaustible character of mines are provided for in the law, as, for example, the establishment of a replacement fund. Neither is special consideration afforded to cover the extra hazards involved in mining. For example, in the average business, the largest part of the investment is protected by insurance, and the expense of that insurance is properly charged into working costs. The largest part of the mining company's investment, however, is represented by the ore in the ground; the great and varied risks that attend the extraction of that ore cannot be insured against. The only insurance protection is afforded by the increased return to the investor. Yet high rate of interest return results in the computation of low valuation, hence low depletion allowance, and consequently, high tax. And then instead of deducting from income his heavy insurance expense, much heavier than in most other industries, the miner pays tax on it as if it were true profit. Furthermore no recognition is given of the difference between unearned appreciation in land values and the increase in mine values revealed by development. Nor are the extreme fluctuations of income from year to year, which particularly affect the mining industry in consequence mainly of its hazardous character, afforded any equalization in the law, which regards the calendar year as the independent unit of computation. On the whole, therefore, it would appear that no valid objection can be raised to the law as in any sense specifically favoring the mining industry.

*Normal Industry Should not be Upset.*—Perhaps the requirement next in importance to equity and finality is that every effort be made to avoid setting up regulations and procedures that will furnish strong incentive to the mining company, in the hope of lessening its tax burden, to adopt practices or pursue policies contrary or foreign to the dictates of good sense and the well-founded customs of the industry. Such a policy would mean bad tax-collecting, bad mining, and therefore, in reality, bad morals. I do not refer to deliberate evasions of a culpable kind, but to acts, which, though legitimate in the sense of not being il-

legal, are nevertheless wrong because artificial, indirect, and probably subversive of the public good.

As an example, there readily comes to mind the case of many ore deposits in limestone where, because of the commonly irregular distribution of the orebodies and the heavy character of the ground when the altered rock is exposed to the air, it is customary to carry development work not far ahead of current extraction. In the matter of valuation on the basis of exposed or proved ore such mines are clearly at a disadvantage with extensively developed mines like the porphyry coppers. If, to overcome this disadvantage, one of these limestone mines should greatly expand its underground development and should thereby discover a proportionate amount of new ore, it might gain a higher valuation and thus, through greater depletion deduction, pay a lower tax. But the money thus saved to it (and lost to the Government) would be partly offset, perhaps eventually more than offset, by long-time interest charges on the expense of the idle development and by the likelihood that when finally needed for extraction purposes, the workings would require heavy repairs or be useless altogether because of caving and sloughing during the long interval of disuse.<sup>7</sup>

Neither should there be temptation, through complicated schemes perhaps not yet discovered, to sell mines which ordinarily would not be sold. No matter how bona fide and complete the change of ownership might be, the policy would be wrong, for in general a mine is worth most to those who have become familiar with it and experienced in mastering the particular problems it presents; it should, therefore, properly remain in the hands of those to whom it is worth most.

Falling in somewhat the same category is the conviction in my mind that, in view of the comparative recency of the income tax as a matter of prime consequence, and of the prevailing uncertainty as yet regarding what the Government desires and requires, it will be improper to refuse allowances, to which a company would otherwise be entitled, simply because its books are not kept in a specified way.

### *Methods of Mine Valuation*

As already pointed out, the latest revenue law provides three ways of arriving at the value of a mining property: (1) The cost, if purchased on Mar. 1, 1913, or later. (2) The fair market value as of Mar. 1, 1913, if purchased earlier. (3) Revaluation in either of the other cases, provided since Mar. 1, 1913, or since purchase subsequent to that date, new dis-

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<sup>7</sup> A case opposite in detail though similar in its bad consequences is the well-known restriction of development in parts of the Lake Superior iron region as a result of applying State property taxes to valuations based on exposed ore.

covery in unproved ground results in a value disproportionate to the value prior to discovery.

Since most mining properties now yielding profit and, consequently, concerned in the income-tax program have not changed ownership since Mar. 1, 1913, we are confronted mainly with the problem of establishing the value of the mine on that date, and perhaps in a considerable number of cases with the clause relating to discovery since that date.

Regulations of the Revenue Bureau for earlier years have outlined the various ways in which fair market value as of Mar. 1, 1913, may be reached. Most of these methods, however, are methods of indirection. The method or methods which I trust may be followed in the present attempt to apply the tax laws to the mines should be methods as direct and professional as possible, *i.e.*, engineering methods.

We have progressed beyond those primitive modes of exchange when beef was sold by the "side," wheat by the "bin," or metal by the "chunk." Nowadays, we insist upon knowing and take deliberate pains to find out how much beef or wheat or metal, and what quality, before we complete a transaction. Likewise, ore is not sold at so much "per mine," nor are mines generally sold at so much per block of ore. Instead, here again, elaborate effort is expended on ascertaining as accurately as possible how much ore is present, of what character and grade it is, and above all, how much profit it can be expected to yield, since in that lies its value.

While valuations gaged by transfers of nearby or essentially similar properties may be reached with some reliability in certain cases of oil and coal lands, since these in recent years have been subject to rather frequent changes of ownership, it is doubtful if methods of that sort will, except in occasional instances, yield any safe basis for valuation of metal-mining properties. Stock-market quotations may, under some circumstances, afford a rough check on valuations arrived at by more direct and reliable methods, but in themselves can ordinarily be given little weight, for a variety of reasons too obvious to require enumeration. And the par value of security issues is likely in most instances to be far too fictitious to be accorded serious attention.

*Present Value of Eventual Earnings Method.*—SCOPE OF APPLICATION.—The pronouncements of economists and the dictates of common sense leave no doubt whatever that the true measure of value of fixed property like farms, city lots, or mines is a capitalization of their income. Lands afford prospect of yielding a practically perpetual income. In their case, therefore, the method of capitalization is a simple division of yearly income by the income rate. Mines, however, since they are of diminishing value in proportion as they yield return, have to be valued in a different way, namely, by estimating the total expected earnings and the total life and from these working back to such a valuation as will afford a demanded annual rate to cover profit and risk and will be itself

returned at the end of the estimated life by a sinking-fund accumulated from annual depletion increments. This present value of eventual earnings method is the method which has been practised for scores of years and within the last decade illuminated particularly by the writings of Hoover<sup>8</sup> and Finlay.<sup>9</sup> So far as I am aware, it is the only definite method of mine valuation expounded in textbooks on mining or in treatises on mining investments. Of necessity, this present-value method of mine valuation must be the corner-stone on which the work of the Natural Resources Sub-division of the Revenue Bureau must build. The fear implied in some of the earlier regulations of the Revenue Bureau that such a method of valuation would permit true income to escape taxation is devoid of economic foundation and is as groundless in the case of mines as it would be of a corner lot on Broadway. Indeed, the provision for profit is the vital feature of the method, and that profit, like any other, is subject to tax.

Mines vary so greatly in character and conditions that no single basis of valuation can be applied indiscriminately to all without grave error in the case of many. This is true, not only as between coal mines on one hand and gold mines on the other, but as between different coal mines to some extent and as between different gold mines or different copper mines to a greater extent. Either each mine must be considered in unlimited individual detail or else classes must be established into which mines of essentially similar character and circumstances shall be grouped and these classes handled as if individuals themselves. The former alternative, if feasible, might give the fairer result, though I am not confident that best balance would be secured thereby. The latter scheme, however, is likely to afford the best practical solution because the single-mine method would require a degree of detail and an amount of time which would render the problem almost hopeless. This does not mean, however, that due consideration of special circumstances in any case will be denied.

Unquestionably the fairest and most defensible method of mine valuation is the present-value method, *provided the essential factors that enter into the computation are reasonably well known or can be arrived at with fair reliability*. Most coal mines, many iron mines, the porphyry coppers, some of the Lake copper mines, and perhaps a few others can be valued directly and satisfactorily by this method because more of the necessary information is available for them than for any others. For them, any other method is likely to be less reliable and less fair. Obviously, also, valuations so determined for such mines will be the most reliable group of valuations of all that will be established. Therefore, it seems to me logical to value by the present-value method those mines to

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<sup>8</sup> "Principles of Mining," New York, 1909.

<sup>9</sup> "Cost of Mining," New York, 1909.

which it will directly apply, in order to establish certain standards, or yard sticks, by which to determine valuation of those mines for which less and less of the necessary data is available.

Let me illustrate why this method of comparing with a standard is desirable and use, by way of illustration, examples from the copper industry with which I am most familiar. A given porphyry copper deposit may be producing 100,000,000 lb. a year at a gross profit of 6 c. a pound and may have an indicated life at that rate of 30 years and a past history of successful production behind it of 8 or 10 years. A limestone mine may likewise be producing 100,000,000 lb. of copper per year at the same gross profit of 6 c. a pound; it may have a successful producing record behind it of 30 or 40 years, yet have actually developed ahead only, say, 3 years' ore supply. Is the porphyry mine to be valued on the 30-year life and the limestone mine on the 3-year basis? Obviously not. How, then, is the limestone mine to be valued? Will not its true value be best arrived at by applying certain properly determined factors to the value indicated for the porphyry mine—factors that will take into account its greater risk in ore continuance or life persistence and that will make needed provision for such other changes or differences as experience has shown are likely to arise between limestone mines on one hand and porphyry mines on the other?

If the conclusions to which these arguments point are sound, the present-value method will be the very keystone of the valuation section's work and a series of modifying factors must be established which will bring other mines into proper balance with those to which the present-value method can be applied directly and without modification.

Right here lies the very keynote and crux of the entire valuation job. If a series of factors, or indices, can be established that are practical, effective, and fair, the problem is going to be simplified immensely. But such an outcome will be quite impossible of attainment except with the closest possible coöperation and assistance of professional engineers and geologists, who collectively possess the vast fund of specific information which such a series of factors must comprehend and codify. By all means, therefore, let the mining companies contribute, through their technical staffs, all the help that they possibly can. The Revenue Bureau hopes to settle this and related matters with the help of conferences to which it trusts those who can assist will come and give all possible help.

**NECESSITY FOR ACCURACY.**—If the present-value method is to be extended to the great majority of cases of valuation, as just indicated, there arises a multiplied obligation that it be applied in an absolutely logical and proper way, and with all reasonable exactness. Inasmuch as the method, at its very starting point, relies on factors, such as tonnage and yield of ores, which are necessarily but estimates and approximations at best, it might seem natural to conclude that all subsequent steps in the

process could, with entire permissibility, be of only corresponding accuracy—that attempt to introduce greater refinements than those imposed at the outset would be futile and absurd. That is the conventional theory of error. Perhaps it is justifiable and sound when the object is the attainment of a proper *average*, for the probability, or so-called law, of averages will ordinarily balance individual low results with corresponding high ones. But in dealing with this tax problem, we cannot be content with a fair average. We cannot satisfy A's complaint by proving to him that B was let off correspondingly easy, so the thing evens up after all." The essential and reasonable accuracy of each individual result is important.

If inaccurate methods are applied all the way through, some cases will inevitably arise in which the sign or effect of the error is the same in most or all of the steps, and the magnitude of the total error thus accumulated may be large—far too large to be knowingly permitted.

The simple logic of the case, then, seems to be this: If estimates that are necessarily low in accuracy have to be used in the early steps, the obligation is all the greater in the subsequent steps, to confine the total error, so far as reasonably possible, to that thus introduced at the start—in a word, not to deliberately permit inaccuracies to enter into the result. When, to a considerable extent, the accuracy of many of the steps in the computation can be determined by choice of method, it is proper to choose those methods which give the most accurate results—unless the working out and application of such methods is too costly in time and effort to be justifiable. There must obviously be a balance struck between degree of refinement and rate of accomplishment. But to deliberately choose sloppy methods because some other steps must be elastic is, in this particular instance, illogical and unpermissible.

While it is unnecessary to defend before this audience the present-value method of valuation, it may be well, in view of the responsibility which it may have to bear, to analyze with care what its consequences will be if used in the taxation program, and to indicate some of the considerations that, in my personal opinion, ought to be given appropriate attention in such an application.

The valuation engineers of the Revenue Bureau, as I understand it, are to answer the question of valuation that is comprehended in the imaginary situation of a prospective buyer, competent to measure mine values and actuated by the hope of profit to be derived solely from mine operation, making an offer for a mine to the owner who is likewise competent to measure mine values and who is under no obligation to sell except such obligation as arises from his belief that the offer made is advantageous to him.

**DETERMINATION OF INTEREST RATES.**—The first question that such a wise prospective buyer would want to determine is the security of his

capital. He realizes that mining is a hazardous and uninsurable business. Therefore, since in all forms of investment risk is reflected in the interest rate, he demands a higher return on his money than he could obtain if he invested it in an ordinary manufacturing business or in a good mortgage. Since the interest rate must thus include both actual profit and compensation for risk, the determination of the rate cannot be based on the mining industry in general, as compared with other industries, when the degree of hazard varies greatly among different classes of mines; different rates must be established for different classes. On these determinations, as well as of proper interest to be credited on the sinking funds, much thought may well be expended.

Let<sup>10</sup> us assume that our prospective buyer concludes, in a given case under consideration, that he should have 10 per cent. on his money each year, in addition to a depletion installment calculated eventually to return his capital sum. As a matter of fact, regardless of whether he spends it outright or invests it in something else or places it, as theoretically intended, in a sinking fund for the positive redemption of capital, his annual depletion installment, if actually received, continually reduces his stake remaining invested in the risky mining enterprise; yet if everything goes well and his original assumptions on the basis of which the valuation was reached prove to be justified, he will be receiving a 10 per cent. return on his entire initial capital through the last year when only a small fraction of that capital is invested in the 10 per cent. risk and the major part has been used in some other way. In reality, therefore, he receives on the average distinctly more than 10 per cent. on the capital that is at risk.<sup>11</sup> The question now arises whether this greater interest return, concealed in the apparent flat rate of 10 per cent., is actually required to offset hazard, or whether on the other hand, an even 10 per

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<sup>10</sup> The following paragraphs on the relation of interest to capital at risk are the result of discussions with my colleague, Doctor Hance, and may, we hope, be elaborated further at another time.

<sup>11</sup> On the assumption that money in an ordinary, good investment is entitled to 6 per cent., it is found that in the case of a property of 10-yr. life, valued to give 10 per cent. on initial sum and amortized at 4 per cent. compounded annually, the ratio of total profit assignable to amount remaining at risk in the property, divided by the total of the amounts at risk during each of the 10 yr., works out to be not 10 per cent. but 13.25 per cent. Similarly, for a 10-yr. life, an apparent 8 per cent. return is found to give an average of 9.71 per cent.; and a 12 per cent. return to average in reality 16.79 per cent. on the money at risk. In the three cases, 8 per cent., 10 per cent., and 12 per cent., these actual average returns are respectively 21.4 per cent., 32.5 per cent., and 40 per cent. higher than the flat rate to which they are related.

Since this paper was sent to the printer, my attention has been called to prior recognition of such disparities, by W. W. Whitton and D. B. Morkill, who wrote on "Formulas for Mine Valuation" in *Min. & Sci. Pr.*, May 18, 1918, and Aug. 31, 1918, respectively. Neither one, however, views the situation exactly as implied above.

cent. on the decreasing sum actually at risk is enough, in which case, the present value of the mine would increase.

It seems highly probable that in the average mining operation, the greater return concealed within the flat statement of rate is not too much to compensate for hazard, and also that the valuation computed on the flat return of say 10 per cent., as by present methods, represents a safer and fairer basis on which to buy and sell a mine than the higher valuation that would arise if the return were limited to an exact 10 per cent. on such parts of the capital as remain in the hazardous enterprise.

Since the money still in the enterprise derives greater and greater interest return with time, it could, therefore, afford to carry greater risk during the late than in the early period of the investment. Clearly enough, in a going mine purchased on the basis of proved and prospective ore, the early years would indeed involve less risk, while, as viewed from the beginning, the later years, necessarily relying on ore less positively assured, would entail greater uncertainty and hazard. The method and the facts thus appear to coincide in direction, and although it may be doubted if the risk mounts at the very end at so rapid a rate as the percentage of return is found to do, or if, on the other hand, the risk of the late middle years is sufficiently covered, it seems likely that no more accurate coincidence can be established save by complex formulas, which would be quite unjustified. Acceptance of the flat rate has behind it, furthermore, the support of accepted custom. Still another advantage is that, because of the rapidly increasing spread in the later years of life between, say, an 8 per cent., a 10 per cent., and a 12 per cent. flat rate of return, justification is afforded for employing, in the computations of present value, rates of interest that do not differ very greatly and yet make provision for a wide range of risk, as for example, a porphyry copper mine and a pockety silver mine.

**EFFECT OF CHANGE IN ORE AND IN PRODUCTION.**—Another phase of the present-value method which appears not to have been clearly set forth in any of the discussions thus far devoted to this subject is that all the assumptions on which this method has been based and all the tables that have been printed as aids in applying it arise from the idea of equal annuities and imply that a given property will mine a fixed tonnage of constant average grade of ore each year throughout its history. All the computations as to life and all the interest factors involved rest on such assumption. As a matter of fact, these assumptions may apply to certain classes of property. They probably do pretty well apply to operations upon a given seam of coal tributary to a developed industrial district. It was to such a condition, I believe, that this fundamental method of valuation was first applied, namely, the English collieries.

But the assumptions of constant grade of ore and a fixed tonnage per

year surely do not apply to many other mines in which this method could otherwise be advantageously used. Many of the mines like the porphyry coppers, which have great reserves of ore established by exploration, will through choice, and must indeed of necessity, work richer ores during their early years and depend upon leaner and leaner ores as their life progresses. Since the richer ores yield not only more metal per ton but also more profit per pound or per ounce of metal, this mining of the richer ores first will tend in a double way to bring realization of eventual earnings into the interest market at an earlier date and will increase the present value of the property. Likewise, such mines, possessing enormous ore reserves, are likely to continue in future, as they have done in the past, to increase their scale of operations and their rate of output so that the actual life of the mine will be shorter than is indicated by any present rate of exhaustion. In this way, also, the realization of the eventual profits will come at an earlier date and the present value of the mine will be enhanced.

Perhaps some justification should be given for the conclusions that have just been stated. First as to the hypothesis of declining grade of ore with time. Almost every influence combines to cause mining of a great deposit to begin on about the richest ore it contains. Some of these influences are:

(a) Most deposits of the class embraced in the long-life-ahead mines decrease in value outward and downward. The decline in value with depth is especially striking in those deposits affected by the geological process of secondary enrichment, but downward decrease is by no means confined to these.

(b) Most such deposits are explored first in their upper central portions, *i.e.*, where the ore is best and where surface indications were probably most attractive, and only with time are the explorations pushed to the lateral and bottom limits of the deposit.

(c) It is natural that actual operation, *i.e.*, ore extraction, shall begin approximately at the point where exploration began. Indeed, commonly, extraction has already been going on there before the marginal portions of the deposit are completely developed. It takes time to gradually extend the mining operations laterally outward to the margins, where the lower grade ore generally lies, and in most instances it takes time to extend operations to the bottom of the deposit, where likewise the grade is lower.

(d) In several instances already passed into history, the figure regarded as the basic economic limit of ore grade a few years ago has now been so lowered by improvements in methods, processes, and experience that what was waste then or of only prospective future value is profitable ore and is being mined now. This tendency will unquestionably persist.

(e) Regardless and independent of improvements implied above in

(d) there will always be a tendency, perhaps more or less unconscious, to make sure now of at least the better grades of ore and to go somewhat more slowly with the lowest grades, in order that still further improvements may come to light which will simplify the problem, or that the difficult job may be passed to someone else.

The foregoing considerations, which are of general character, are amply confirmed by actual experience in case after case. The same conclusion is indicated by the general changes in ore grade for the country as a whole. For example, definite statistics as to average yield of copper from all copper ores produced in the United States were first compiled by the United States Geological Survey in 1906 and are now available through 1916. These show that the tonnage of copper ore mined has increased from 18,000,000 in 1906 to almost 58,000,000 in 1916, and that in the 11-year interval the yield of copper from this ore has declined from 2.5 per cent. to 1.7 per cent. If the great tonnage of low-grade native copper ore from Michigan is excluded, because it has stood nearly stationary in percentage yield (declining in the period only from 1.25 per cent. to 1.08 per cent.) the remaining copper ores have fallen from a yield of 3.56 per cent., in 1906, to 1.86 per cent. in 1916, a drop of almost half. Changes of similar nature are indicated for the other principal metals.

Turning now to the second question, that of increasing rate of production, here again we have abundant evidence, both general and specific, most of which need not be entered into here. It may be pointed out, however, that if declining grade of ore must be handled, as I have just endeavored to establish, that disadvantage generally implies the necessity of so increasing the output as to bring down unit cost to a proper level. An influence of probably even greater importance lies in the fact that in the 21 years between 1896 and 1917 (the only span for which reliable statistics are available) the copper consumption of the world has increased from 766,000,000 to about 3,150,000,000 lb., or at an annual rate of slightly over 7 per cent.—that is to say, the consumption in 1896, if compounded annually at 7 per cent., would give the consumption for 1917. This increasing demand has caused increasing production. There being no prospect of decrease in the rate of consumption growth, production must likewise expand in the future. This growth in production will come, in part, from newly discovered mines, but beyond question much of it will come from those mines now existing which have great deposits developed and to which there is strong financial incentive, or what may be called economic compulsion, to produce and sell their product as rapidly as the world's market will allow. As a matter of fact, for the 36 years back through 1882, when reliable copper statistics were first compiled and when the American copper industry and the applications of electricity were both just becoming important, the output of copper in the United States has grown at a rate just about equal to an annual com-

pounding at 9 per cent.,<sup>12</sup> that is, from 90,000,000 to 1,908,000,000 pounds.

The importance of these factors of declining grade of ore and increasing rate of production becomes very real in the case of mines of assured long life like the porphyry coppers. Let us suppose that a given mine has developed an immense tonnage as follows:

| Tons                               | PER CENT. |
|------------------------------------|-----------|
| 20,000,000 expected to yield       | 2.00      |
| 40,000,000 expected to yield       | 1.75      |
| 60,000,000 expected to yield       | 1.50      |
| 80,000,000 expected to yield       | 1.25      |
| 100,000,000 expected to yield      | 1.00      |
| Total 300,000,000 of average yield | 1.33      |

Let us suppose further that this deposit is now being mined at the rate of 5,000,000 tons per year, indicating a life at that rate of 60 years. Assuming an 8 per cent. return on the purchase price and redemption of capital by a sinking fund compounded annually at 4 per cent., the indicated present purchase price of \$80 worth of eventual total earnings is \$15.84. Such would be the present value indicated by the tables of Inwood, Hoskold, and others.

But if we assume that the richer ore is mined first and the lowest grade ore mined last, the indicated present value becomes \$19.77 or an increase of 25 per cent. If, in addition, we assume that the present rate of output of 5,000,000 tons a year will be increased each year, say, by 4 per cent., which indicates a doubling of mill capacity in about 18 years, and a tripling of capacity in about 28 years (surely a conservative assumption for porphyry deposits), the life of the mine changes from 60 years to about 31½ years. The present value, or indicated purchase price, then becomes about \$22.40 by increased capacity alone, or about \$24.75 by combination of increasing capacity and declining grade, or respectively 41 per cent. and 56 per cent. greater than the value indicated by the tables now in general use. Still further increase in present value would be afforded if we considered the greater profit per pound yielded by the higher grade than by the lower grade ore.

These factors, it seems to me, will have to be given serious consideration and statistics will have to be compiled to show how mines of various classes are likely to change their rates of production and how the ore that they mine is likely to change in grade. Then certain groups will have to be established to which a scale of factors indicated by these past-history statistics must be applied.

<sup>12</sup> The disparity between this figure and the smaller rate of the world's consumption is, of course, not due to accumulation of stocks but to the fact that all other producing countries have not fully contributed their share to the total increase.

In arriving at fair market value as of Mar. 1, 1913, the Revenue Bureau has hitherto followed the policy of taking into consideration only the facts that were known on that date or that could have been then known had one endeavored to learn them at that time. The question may, therefore, arise as to whether it is fair to arrive at a 1913 valuation by applying to the standard present-value method of mine valuation modifications which have not been proposed until 1919. In my own opinion, there is sufficient justification for using those modifications that are consequences of taking into account changing grade of ore and changing rate of production. The justification is this: In 1913, and since that time, there was no actual method followed for valuing mines for purpose of sale, for the reason that mines of the size to which these newly proposed factors would apply are rarely, if ever, sold. In arriving at a market value as of 1913, therefore, we are dealing with a wholly hypothetical question. If there had been occasion to value such mines for sale in 1913, it is unbelievable that factors so important as the change in grade of ore and the likely change in rate of production would have been ignored. In other words, if a market value had been required at that time, it would have been reached in accordance with the methods now proposed.

**DETERMINATION OF PRICE OF PRODUCT.**—In arriving at valuations by the present-value method, certain of the data must originate with the mining company, namely, tonnage and grade of ore, percentage of extraction, and cost and rate of production, for these various factors either are direct consequences of the nature of the mineralized ground which the company owns or are results of the policy and methods which the company chooses to apply. Of course they will all be subject to check by the engineers of the valuation section of the Revenue Bureau. There is one necessary factor, however, which must come from other sources than the company concerned, namely, the probable selling price of its product over the period of indicated life of the property, for the reason that the selling price is something over which the individual producing company does not have more than slight and indirect control. That the selling price is a factor of utmost consequence in the computation of present value has been emphasized by previous writers; therefore careful and detailed research must be put upon this subject when so vital a job as valuing all the profit-making mines of the country is to be faced. It will not do simply to sit back and say the best index of the future is what has happened in the past and then make a flat arithmetical average of prices of the past 10, 20 or 30 years and assume that the same flat average will persist for a corresponding period to come, especially if the average of the past is made up of a low price at the beginning of the period and a higher price at the end, or vice versa. In such cases, the trend rather than average is important, yet it must be ascertained whether

the trend is in itself but part of a minor fluctuation that is a component of a greater trend.

In endeavoring to reach an idea as to the price which copper may be expected to bring for the next 10 or 20 years from 1913, I have prepared a sort of syllabus which might contribute information toward the answering of that question and will sketch it only partly and in merest outline to indicate the extent to which it is possible to go with any of the mineral products, provided such degree of refinement proves justifiable.

#### AIDS IN DETERMINING FUTURE PRICE OF COPPER

1. General methods of economists in predicting future prices of commodities, and their predictions.

2. Price trend of principal commodities for say 20 years prior to 1914.

3. Price trend of principal metals for say 20 years prior to 1914.

4. Price trend of principal copper for say 20 years prior to 1914.

5. Copper-price predictions of others.

6. Details of copper-price fluctuation.

7. Curves showing relations of copper production and consumption to price, for the United States and for the world.

8. Copper consumption per capita in principal consuming countries during past years.

9. Ratio of bulk to price for copper is such that transportation factor is subordinate. Therefore, production of any locality competes in the world's copper market. Contrast with coal, oil, and iron which have a higher bulk to value ratio and, therefore, more localized realms of competition; and on the other hand, with precious metals having a much lower bulk-value ratio and, therefore, affected more by whim and caprice than by the steadier effects of industrial or economic balance.

10. Probable future cost of copper production.

11. Substitutes for copper.

12. Growth in accumulation of old copper.

13. New uses for copper.

14. Increase or decrease in known uses of copper.

Each of these items is capable of considerable elaboration and expansion, as may be illustrated, for example, below in the case of No. 10, "Probable future cost of copper production." This matter of cost of production is so intimately bound up with the problem of available copper supply as to make it a question which is the more fundamental. But in any event, it is clear that the price at which copper must sell in the future must yield a profit above the marginal cost of production for the minimum quantity required.

#### 10. *Probable Future Cost of Copper Production.*—

(a) Sources of supply.

(1) Deposits now known and worked. Statistics of reserves and of exhaustion up to date.

(2) Deposits now known but not worked. Remote deposits; red-bed type.

- (3) Deposits not yet discovered. The outlook in various regions; expenses of exploration; advances in geological methods and skill; availability; transportation.
- (b) Effect of increasing depth. Statistics.
- (c) Recovery from tailings, waste dumps, pillars, fillings, etc.
- (d) New or improved methods or processes.
  - (1) Mining.
  - (2) Treatment: leaching in heaps or in place.
- (e) Utilization of byproducts.
  - Potash? Sulfur, sulfuric acid, fertilizers.
- (f) Wages.
- (g) Other costs: fuel, power, timber, supplies, etc.
- (h) Average spread in past years between cost of production and selling price.
  - Constancy or fluctuation? Trend?

**PROVED AND PROSPECTIVE ORE.**—A matter upon which all possible illumination is desired from mining engineers and geologists is the proper handling of probable and prospective ore in the computations of tonnage. As Hoover has so aptly said of this matter of prospective value, no engineer can approach it with optimism, yet the mining industry would be non-existent today were it approached with pessimism. My own feeling in this connection is that the decisions reached must arise from and be in accord with a thorough understanding of ore deposition and occurrence rather than rest on any arbitrary or conventional limitations and rules.

**Discovery.**—The clause in the latest tax law which permits revaluation of property if discoveries made by the taxpayer have caused a real change in value, is clearly going to be difficult of application. Without endeavoring at this time to indicate either the present attitude of the Bureau on this subject or my own opinions regarding it, I wish to emphasize that suggestions from the mining industry as to the application of this discovery clause will be very welcome in Washington and will undoubtedly aid in the solution of this difficult and important question. Particular attention may well be directed to these questions: What is meant by discovery of a mine, what constitutes discovery according to that meaning, and when is such discovery achieved or completed?

**Depletion Rate.**—Question has been raised as to how or at what rate depletion is to be allowed, *e.g.*, whether coincident with the exhaustion of the deposit, or at a faster or slower rate. This is another of those matters upon which professional advice will be welcome. In the meantime, I may confess that the plan of allowing depletion in direct proportion to the actual annual impairment of the mine value by extraction of the year's ore seems to me most equitable and probably simplest of application. In this connection, it may be pointed out that if such coincident rate of depletion is adopted, the actual depletion allowances should be computed not on number of tons of ore, assumed to possess average

grade, mined during the year, nor on weight of metal actually produced, but on the value in the ground of the ore extracted during the year.<sup>13</sup>

### *Depreciation*

The remarks thus far made with respect to valuation are related primarily to the relation between mine values and depletion deductions. The matter of proper depreciation allowances on physical property must also be decided. In this connection effort will be made to determine the intent of the law with respect to those three main factors ordinarily comprehended in the inclusive term depreciation, namely, physical wear or decay, obsolescence, and inadequacy. Also, effort will be made to settle on a sound principle of depreciation, that is, to decide as between one of the several methods now current, such as the straight-line method, the reducing-balance method, or some other. Due consideration ought to be given to the fact that the usable life of equipment may outlast the life of the property on which it is to be used and a correspondingly rapid rate of depreciation, therefore, allowed from the start. The idea has been expressed that such an outliving of a mine by its equipment will fairly be cared for by finally charging off the remaining balance of value in the equipment against the final year's income when the property shall be wound up. This theory fails, however, when confronted with the practical fact that in the final year of wind-up, there is ordinarily no income or not sufficient income from which to deduct large items of liquidating depreciation. It will also be recognized that the salvage value of specialized equipment in remote districts may range from low to nil.

### *Excess-profits Tax*

The excess-profits tax raises problems which all of us might well wish to escape, but which nevertheless must be faced and solved. No effort will be made in this paper to go into its details, but I may express the conviction that the assistance which the valuation engineers will afford in arriving at the fair quantities to be taken for invested capital, paid-in surplus, and earned surplus for the mining industry will necessarily rest upon the true conceptions of the nature of investments of capital in mining enterprises and on the sound and accepted economic theory that in this hazardous industry, occasional great gains to lucky or shrewd investors must be accepted with equanimity; a policy of control that is too grasping overreaches itself.<sup>14</sup> For quite outside of any ethical questions that may be involved, this practical situation has to be faced; that taxes which take up to 80 per cent. of net income must be applied with due

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<sup>13</sup> Suggested by discussions of Messrs. Paul Armitage and A. D. Brokaw.

<sup>14</sup> F. W. Taussig: "Principles of Economics," 2, 101. New York, 1917.

consideration of the necessity that profit-making industries must survive in order to supply the heavy taxes that will apparently be required for years to come. To whatever extent is proper, also, account should be taken of the fact that the pre-war average of earnings of the mining companies was on a higher percentage level than the earnings of ordinary enterprises because, as emphasized several times in this paper, those earnings include cost of insurance in the one instance but not in the other.

### EFFECT ON LOCAL TAXATION

Quite apart from the direct considerations of the subject of Federal taxation of the mines is a matter to which many of the mining companies have already, no doubt, given attention, namely, the effect of the Federal tax policy upon state, county, and local taxation. Deliberate valuations must, of necessity, be applied by the Government to most of the profit-making mines and other producers of natural resources in the country. To no other group of industries will such official and conspicuous valuations be applied. It may easily follow, therefore, that the true values set upon mining property, which are likely to be higher than most previous values for local taxation purposes have been, will result in the mines of those regions where the property tax prevails carrying a disproportionately heavy part of the local taxes, for the reason that all the other property except mines will not be brought up correspondingly to its true market-value level. In securing the benefit to be derived from full and fair valuation of their properties for the Federal income and excess-profits taxes, it is to be hoped that the mining companies will not suffer injustices arising nearer home, and it is to be desired that the local tax commissions may be brought to see this matter in the proper light.

### DISCUSSION

R. V. NORRIS, Wilkes-Barre, Pa.—Mr. Graton's paper on the subject of mine taxation should elicit most fully the help he requests from our profession, and he should be supplied freely with all available data, and given all viewpoints that may assist him in the extremely difficult task his committee has been given.

We all most thoroughly appreciate the fairness of the Commissioner of Internal Revenue and his desire to give the coal-mining industry a square deal and no especial favor—this is all we ask—and we congratulate him on his decision to obtain engineering advice, and mining engineering advice at that, in the attempted solution of the extremely difficult problem that has been thrust upon him. And speaking, if I may, for the mining engineering profession as a whole, we recognize our responsibility

and are willing to help in any and every way we can in formulating and determining the methods and limitations involved in the general problem of mine taxation.

The taxation of coal properties, *i.e.*, their valuation, is not in many respects similar to that of other mining properties. Coal mining is more nearly in the class of manufacturing than is the mining of metals, with the difference of a wasting and irreplaceable raw material. The tonnage available on any property is subject to reasonably accurate estimate; the grade of mineral is constant; the character of the deposit is regular, except as to the Pennsylvania anthracite and some few western coal areas; the extent of deposits is generally known or readily ascertainable; and the mining problem is that of a low-grade material of wide distribution and relatively low cost, but involving the handling of huge tonnages, where the cost of operation rather than the varying value of the mineral is the important factor.

*Methods of Valuation.*—Mr. Graton has struck the keynote in insisting on valuations based on the present value of prospective earnings, which is unquestionably the only proper method of valuation of coal properties, *i.e.*, as going operations; but in his necessarily condensed paper he has not touched on the question of the valuation of coal properties under lease at tonnage royalties, yet a very large portion of the country's coal is mined from so-called leased properties, on a tonnage-royalty basis.

Prior to the income tax law passed in 1919, no recognition was given to any equity to the lessee in such so-called leased properties, but in this law such possible equity was recognized. In the case of a lessor who has a constant tonnage royalty, regardless of the profits or losses of the lessee, the returns can and should be divided into interest on the value of the property and depletion to amortize its value in its probable life; and, as these returns are practically independent of mining profits, the legal rate of 6 per cent. should be used in calculating the value of this property. In the case of term leases, which are rare, the value of the property should be calculated, taking into consideration the probable going royalty of the region at the time of release or renewal, rather than calculating for the entire life of the property, at the royalty of the lease, which will probably be far lower than the new royalty obtainable.

The mining risks, as applied to coal, include, as a very small consideration, doubt as to the continuity of the deposit. This fact is subject to reasonably accurate estimate, so the life of any coal property is determined by the rate of output. This, in turn, dependent on market conditions, is largely under the control of the operator. Hence the "hazard of ore supply" of the author is, in the case of coal, very slight. The hazards of operation in coal mining are, gas, water, dust and squeeze. Of these, the greatest hazard is explosion, either gas or dust or both, but these hazards should be taken care of by a "reserve for mining hazards"

carried as an operating expense, rather than by an abnormal interest rate used in calculating present value.

*Profits.*—The profits of coal mining per unit of output are very small, the earnings being dependent not on a high unit profit but on very large output, with a small unit profit. The 1910 census returns showed less than 2 per cent. return on invested capital for all bituminous-coal operations, not including depreciation, and only  $4\frac{1}{2}$  per cent. on anthracite operations under the same conditions.

The author's statement that the capital invested must be returned by reserves for depletion and depreciation is absolutely sound and fair. Such reserves should be sufficient to replace the exhausted coal at the going price at the time of exhaustion, not merely to amortize the cost, or the estimated value Mar. 1, 1913, the date at which the first income tax law happened to be passed.

That the coal business is and should be a continuing industry is, of course, unquestionable. The author indicates that this continuation of the invaluable organization must be by the purchase, from time to time, of new mines at the then going price. In the case of the coal industry, this long and indefinite life is more reasonably attained by the control of territory or tonnage not available at the present time, either by reason of its distance from shipping facilities, its location in relation to possible development, or its depth rendering its present exploitation financially impracticable. Such reserves should not be considered as available coal, which in fact they are not, but should be carried as "reserves unavailable." It is a fact that, considering local taxation and carrying charges, coal reserves that cannot be mined within a reasonable time, 40 to 45 years, are of no present value and are not properly subject to depletion charges. They, therefore, should not be considered in calculating the present value of coal property.

There is but small probability of new discoveries of coal of sufficient amount to have any considerable influence on the total known to be available in the United States. Enormous reserves of coal, not now of any economic value, are known to exist, though unavailable by reason of location beyond the probability of transportation within a reasonable time, by reason of depth, and by reason of the quality being too low to allow competition with other known coals available to the same territory.

Such deposits have no present value and if held as future reserves by present operating companies, such holding should be considered as a public benefaction and should not be discouraged by the imposition of taxes. Coal now commercially unavailable held by well-organized operators promises the continuation of a valuable organization to the ultimate benefit of the body politic.

While the author shows that even in 1917 coal comprised over 30

per cent. in value of the total mineral output of the country, he fails to point out that, as a low-grade product, it supplied over 80 per cent. of the total tonnage of all mineral products, and actually provided nearly one-half of the total tonnage transported by the railroads. The proper encouragement of coal production is, beyond all other, vital to the prosperity of our transportation systems and, hence, to our country as a whole.

*Questionnaire.*—The author refers to the questionnaire sent to all mining companies. May I suggest that this, while probably excellent for metal-mining conditions, is unsuited to coal. It does not speak the "coal language;" many of the terms used are incomprehensible to the coal miner. The requirement of maps showing operations is preposterous. A single company whose operations were recently examined by the writer would be required to furnish a map, on the standard scale of 1 in. equals 100 ft., 36 by 64 ft.; and in the case of the anthracite operators mining a great number of beds, even more extensive maps are in use. There would hardly be available room in the Treasury Department to file the maps that might be furnished, and no living engineer or combination of engineers could properly and scientifically study all of these. The request should be, at the most, for small-scale maps showing the areas worked over, exhausted, and the areas of solid coal remaining.

*Interest Return.*—The author very properly states that the high rate of interest return results in low valuation and low depletion allowance, hence high tax, and the miner pays tax on his insurance expenses (mining risk) as a profit. Hence it is clear that, as far as coal mining is concerned, a high rate of interest in figuring the present value of a coal-mining property is not warranted.

I would respectfully suggest that the present value of coal properties be calculated on the base of 6 per cent. interest plus the percentage required to amortize the value of the property at its exhaustion; and, further, that the date of exhaustion be taken with extreme conservatism. Experience shows that the last few years of life of a coal property are more likely to produce tonnage than to produce profits. The author states that, in his opinion, there is no valid objection to the law as favoring the mining industry, in the matter of assuming a high rate of interest return (and resulting low valuation). I would suggest that while this is absolutely correct, there is a very valid objection due from the coal-mining industry; such a high rate of interest is an unjustifiable discrimination against it. Six per cent. plus the necessary percentage to amortize the property value is all that is justified in calculating present values in the case of coal mines.

The author states that, in the case of coal land, valuations may be reached with some reliability by sales. As sales of operating and successful properties are rare, this is assuming that the value of such proved, opened, and successfully operated properties may be fairly determined by

sales values of adjoining lands, perhaps unproved and unopened. I do not believe that this is sound. The value of an operating property should properly be based, as the author elsewhere states, on its present and probable future earnings, in which earnings, organization and management are a dominant factor, or in the case of properties when such values are not available I believe that calculations based on the going rate of royalties for the region in question will give reasonable though probably too conservative values.

As an example, in an operation once examined by the writer there was found a consolidation of two companies, *A* with two-thirds the total investment and a losing proposition and *B* with one-third the investment but making reasonable profits. In the consolidation *A* took one-third and *B* two-thirds, and justly as the consolidation made good money for both. *A* was a losing proposition only because of the management; the physical conditions of each company were identical. I do not believe that competent and successful management should be penalized by taxation, hence I agree with the author that district averages should control.

The author properly comments on the necessity for accuracy in calculations, as far as such are subject to mathematical treatment; all estimates of value based on future results are necessarily approximations, and it is manifestly improper to further add to the approximation by methods involving unnecessary errors. The author is absolutely correct in urging that no "sloppy" methods be used, and that only such matters, distinctly noted, as are matters of estimate or judgment be treated with other than mathematical accuracy.

*Interest Rates.*—As has been previously indicated, as regards the coal business a present value based on the legal rate of 6 per cent. interest, plus a depletion allowance, is proper. The interest rates, suggested by inference, of 10 per cent. to 12 per cent. are too high for this highly specialized business, which depends for its profit on great output and not on high unit profit.

Such elements of profit as stores, lumber, byproducts, etc., not essentially mining, should not be included in either costs or profits, but the colliery settlements, houses, schools, churches, clubs, parks, amusement halls, and the like are essential elements of the business, and their financial result, be it profit or loss, is properly included in operating expenses.

Referring largely to metal mining, the author states that the early risk is less than the later. This does not generally apply to the coal business, in which the risk in opening a property, proving the coal, and finding a market is largely in the early years of any operation. Once opened, proved, and established in the market, the future of a property, barring labor troubles, is fairly assured, and such establishment of an operation is properly credited in any estimate of value.

*Tonnage.*—The author's proposition that a given property will insure a fixed tonnage, equal year in and year out, is incorrect as applied to coal mining. The history of practically all mines shows a small tonnage at the beginning of operations, increasing relatively slowly in the early years, a rapid increase when development is completed, a certain life at maximum tonnage, a rapid fall during the obsolescence of the property, and a stoppage of operations when, due to the large area mined, the cost of operation becomes financially prohibitive. Hence, in estimating the present value of coal properties on the basis of present and prospective profits as is most proper, it is erroneous to use an average output to exhaustion. Careful studies should be made of past and future development, the future output should be carefully estimated, and the calculations of present value based on this varying output, with increased costs for smaller than normal tonnage.

*Valuation.*—In studying present value as of 1913, as indicated by the author, it is not proper to directly apply data of later years. But, in the opinion of the writer, it is proper to study the trend of conditions up to 1913, and to predict future conditions on the basis of past variations. Further the writer feels that, except for the war years, war conditions are not a proper base for calculations, but in calculating values as of 1913 he does not hesitate to use the actual results available of years subsequent to that date, using, however, for the future figures based on general conditions up to March, 1913; that is, abnormal profits or losses during the period of the war, are, in the opinion of the writer, properly considered in obtaining values as of Mar. 1, 1913. It seems preposterous to make calculations on data that, to the engineer, are known to be far from the facts, and the writer declines to thus stultify himself; but for future probable costs and profits, war conditions should be eliminated but the general upward trend of costs and prices should be considered.

In determining profits as of the future, Mr. Baer's theorem must be considered; "The price of the entire supply of anything necessary to a community will be regulated by the cost of production of that portion of the necessary supply that is produced at the greatest expense." The price of coal is not fixed by the lowest cost producers nor by the average cost of production, but by the cost, with a reasonable and minimum profit, of the high cost necessary coal. This method of price fixing, which is the law of supply and demand, was used generally by the United States Fuel Administration in the so-called "bulk line" principle and also by the Price Fixing Committee of the War Industries Board, on which Committee the writer had the honor of serving.

As a matter of fact, under normal conditions, competition in the coal industry is so keen that only a minimum profit is obtainable for the higher cost operations (and none for the very high cost producers); hence increases in price are primarily and practically only due to increases in

operating costs incident to labor increases, or to higher costs of necessary supplies. It is believed that, owing to this intense competition, the margin between cost and selling price will remain fairly constant. Hence, a valuation based on such margins averaged on recent years will fairly represent the probable future profit and this forms a reasonable basis for valuations either for sale or purchase, or for the purposes of taxation. This is believed to be reasonable as the supply of coal in this country, estimated at over 1000 years, is for the present generation practically inexhaustible, hence the output and price is regulated by the demand not by the supply.

The author suggests that depletion is best calculated on a per ton basis. The writer can conceive of no other reasonable method and has recommended depletion on a tonnage basis calculated from the value of the property and the tonnage probably recoverable within a reasonable time, omitting from the calculation both the value (usually negative considering carrying charges and taxation) and estimated tonnage of lands probably containing coal not minable within a reasonable time (40 to 50 years).

*Depreciation.*—Depreciation charges should be based on the life of the property (obsolescence) when all improvements become of only scrap, or nominal, value; or, in the case of very long-lived properties, on the probable useful life of such improvements. As an example, shafts, slopes, or main openings may be properly considered to have a life equal to the life of the property or bed opened by them, but not to exceed 45 years; local tunnels, the life of the coal tributary; buildings and structures, not to exceed 20 years; machinery 15 years; and animals, based on experience, 5 years. All these maximums must be reduced so as not to exceed the estimated life of the colliery properties.

The author also calls attention to the danger that proper valuations for Federal taxation may result in undue and unfair local taxation. In general, the local taxation of coal properties is reasonably fair, in some states as Virginia, and West Virginia, notably so. These states base values on the sliding scale of values, thus:

A. Coal immediately available, taxed at a high valuation = the acreage mined out the preceding year.

B. Available coal 10 years; A times 10, about one-half of the A valuation.

C. Available coal deferred, A times 10, at a fairly low valuation.

D. Unavailable coal, all other holdings, at a nominal valuation.

In sharp contradistinction some of the anthracite counties of Pennsylvania are attempting to impose a valuation for taxation purposes based on \$500 per foot-acre; or on the best average lands containing 60 ft., of coal, a base of \$30,000 per acre. This is in the face of sales rarely exceeding \$3000 per acre for the 60 ft. territory. Of course such excessive

valuations are being resisted in the courts, and thus far the decisions have very materially reduced this preposterous valuation.

In conclusion, the writer tenders to the Treasury Department any information he may have or may be able to obtain, and he believes that he may also tender the cordial coöperation of practically all of the coal operators of the country.

R. D. PATTERSON,\* Dayton, Ohio (written discussion†).—Mr. Graton emphasizes many points that are of vital importance. The relation of capital to the mining industry differs from its relation to almost any other undertaking. The industry, on account of the many hazards incident to the business, the many conditions over which it has no control, the rapid deterioration of physical plant and equipment, and the constant wasting of its mineral assets, necessarily must show a greater return on investment than that of an industry in which these factors do not prevail. Furthermore, reserves to provide for possible hazards are a proper element of cost and should be treated as such in making our returns to the Treasury Department. This is a non-insurable risk, yet an explosion, fire, or some such hazard which frequently occurs in the mines may mean the wiping out of all profit accumulation of former years in an attempt to restore the property to its original condition, or else the capital may be impaired by the operator having to borrow money to put the mine in a workable condition. I am glad to know that the Treasury Department realizes all these factors, and I trust this discussion of these matters will result in a much better understanding of the problems of the industry.

CLINTON H. CRANE,‡ New York, N. Y.||—In order to determine a fair basis for depletion, first, a fair market value of the property as of Mar. 1, 1913, must be determined. Having determined this, the annual sum necessary to return this fair market value to owners at the exhaustion of the mine is a matter of simple arithmetic based on the same factors that are used in determining the market value of the mine. The four basic factors to be determined are: Average market price of product; average costs of product; the life of the mine; the allowable interest rate.

The average market price would be the price that the producer might reasonably expect to receive for the mine's product during the life of the mine. In determining this average price, the history and average market

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\* President, Weyanoke Coal and Coke Co.

† Received Oct. 6, 1919.

‡ President, St. Joseph Lead Co.

|| This paper, written by Mr. Crane in 1917, was submitted as part of the discussion, with his permission.

price over a period of years past must be considered. Such a price, which we may call the normal price, has usually been used in all estimates in valuing a mine. For instance, the average price of copper for 30 years prior to 1915 was 14.06 c.; the average price of tin was 27.63 c.; the average price of lead was 4.25 c.; the average price of common spelter was 5.36 cents.

The average costs would vary for each individual mine. It would be the average cost for producing a given unit of output in normal times. This average cost might be per pound of copper, per ton of ore, or per ton of concentrates, depending on its application to value as to whether the metal itself was marketed or whether the ore or concentrates were marketed. It could be determined with reasonable accuracy for any year by dividing the annual profit by the total number of tons or pounds produced and subtracting this profit per ton or per pound from the average market price per pound of that year. This would make no allowance for interest on investment nor for operations other than mining that might be carried on by the company in question, but such refinements of cost could be readily allowed for and justified by each individual company doing a more complex business. For the purposes of this memorandum refinements in regard to interest on capital investment, and on more or less development work, the fact of varying costs through the life of the mine, due to variations in efficiency and wages, need not be considered.

The life of the mine would be the total number of tons of ore in the mine divided by the annual output. For the purpose of this discussion the annual output is assumed to be constant. The total number of tons of ore is the total estimated tonnage as of Mar. 1, 1913. The difference between the average price and the average cost would be the average profit per pound or per ton. This sum multiplied by the annual output would represent the average annual income expected. This annual income is like an annuity for a certain number of years; that is, an income for the number of years that the mine has life. The present-day value of this income is a matter of simple actuarial determination varying only with the amount of interest allowed. For instance, an annual income of \$100 extending over a life of 20 years which will produce 2000 actual dollars in that time is only worth \$1146.99 if the interest rate is 6 per cent. The same income for 10 years is worth today \$736.01. That same income received for 40 years would be worth today \$1504.63. This present-day value of the mine or mining property is the capital value that should be allowed for depletion under the terms of the act. Now let us see what sum it is necessary to set aside annually so that at the exhaustion of the mine the present-day value of the mine may be returned to the mine's stockholders. This would obviously be an annual payment that will produce, in the number of years that the mine is to last, a sum of money equal to the present-day value.

To return to our examples: The present-day value of the \$100 a year income lasting for 20 years is \$1146.99. The annual payment to a sinking fund that would be required on a 6 per cent. basis to produce this money at the end of 20 years would be \$31. The present-day value of the \$100 a year income lasting for 10 years is \$736.01. The annual payment to a sinking fund that would be required on a 6 per cent. basis to produce this money at the end of 10 years would be \$56. The present-day value of the \$100 a year income lasting for 40 years is \$1504.63. The annual payment to a sinking fund that would be required on a 6 per cent. basis to produce this money at the end of 40 years would be \$9.72. This, in each case, is a definite per cent. of the annual income.

Now as we have shown that the present-day value of the mine is dependent on the annual income and the number of years that this annual income will be paid, it is obvious that the per cent. of this annual income that should be set aside for depletion is a variable depending on the life of the mine. As the life of the mine becomes greater, it is a smaller and smaller per cent. of the estimated average income. In the case of a mine having only 1 year of life, a fair amount to be allowed for depletion would be 94 per cent. of the annual income, while in the case of a mine with a 40-year life, it would be only 10 per cent. of the annual income.

The allowable interest rate would be 6 per cent. per annum. The present value, the estimated life, the average annual income, and the sinking-fund payment necessary to return the present value at the exhaustion of the mine having been determined, all these factors being based on the law of averages, it would then be fair, in the case of any individual year, to allow for depletion the same part of actual income as the ratio that the annual payment to the sinking fund bears to the average annual income. For instance: In the case of a property with a 20-year life, the annual sinking-fund payment would be 31 per cent. of the average annual income and such a property would be allowed to charge against its current earnings for depletion 31 per cent. of its earnings. As shown, before, these percentages will vary for each mine.



## Titaniferous Iron Sands of New Zealand

Discussion of the paper of V. W. AUBEL, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2081.

F. E. BACHMAN, Port Henry, N. Y. (written discussion\*).—Experiments with titaniferous ores found in Essex County, New York, made by the MacIntyre Iron Co. in 1914, showed<sup>1</sup> that titaniferous concentrates are reduced in the furnace with no greater, and probably with less, expenditure of heat, and consequently of fuel, than non-titaniferous magnetites; and as a greater proportion of their oxygen is removed by carbon monoxide than is the case with non-titaniferous magnetites, a lower fuel consumption for the reduction of iron may be expected.

After the furnace was blown out at the end of the experiment, the formation in the hearth was found to be abnormal. The brickwork was replaced, entirely around the furnace, by a layer which at the tuyere circle was made up of cinder, fine carbon, and coke; the coke, however, gradually disappeared toward the bottom, being replaced by cinder and graphite.

The usual salamander of graphite and iron was missing. The material left in the hearth seemed to be cinder that had not drained from the last cast; its composition, though, would indicate that it was in the furnace previous to the taking off of the titaniferous ore. At first, this material was thought to be blast-furnace cinder mixed with less iron and graphite than is normal; but an examination showed it to be made up of cinder with small masses of iron and graphite. There were also patches of a steel-gray material having a metallic luster; a microscope showed these patches to be made up of black metallic crystals interlacing white crystals.

As there had been no indication of the furnace hearth having been filled with unmelted material, and as iron and steel bars had been driven several times into the hearth of the furnace to a depth of at least 18 in. (45 cm.) below the top of this layer, this material must have been present in the furnace in a melted state. Determinations of its melting point and fluidity tests indicated that it had a low melting point but did not become fluid enough to flow at furnace-hearth temperatures. As its specific gravity was apparently very much below that of cast iron, I concluded it was present in a layer resting on the iron. All analyses of this material indicate excessive amounts of sulfur and titanium.

*Analyses of Salamander.*—Suspecting that this material caused the "dirty hearth" condition, which was the only abnormal condition not

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\* Received Sept. 28, 1919.

<sup>1</sup> American Iron and Steel Institute *Year Book* (1914), 371-419.

met and overcome during our run on titaniferous ores, I sent some to Mr. Porter W. Shimer, Easton, Pa., for analysis. His report is as follows:

The piece was broken down coarsely and sampled. A portion weighing 103½ gm. was ground down, with much difficulty, so that 96 gm. passed through a 100-mesh sieve; 7½ gm. of small iron particles remained on the sieve. The part that passed through the 100-mesh sieve was used, in its air-dried state, for the full analysis, which follows:

|                    | PER CENT. |                       | PER CENT. |
|--------------------|-----------|-----------------------|-----------|
| Metallic iron..... | 23.16     | Magnesia.....         | 2.49      |
| Titanium.....      | 29.34     | Calcium sulfide.....  | 13.61     |
| Vanadium.....      | 0.15      | Potassa.....          | 0.20      |
| Chromium.....      | 0.00      | Soda.....             | 0.27      |
| Nickel.....        | 0.00      | Combined carbon.....  | 3.39      |
| Manganese.....     | 0.13      | Graphitic carbon..... | 0.94      |
| Silica.....        | 10.06     | Nitrogen.....         | 3.86      |
| Alumina.....       | 4.54      | Moisture.....         | 0.32      |
| Lime.....          | 7.02      |                       |           |
|                    |           |                       | 99.48     |

Sulfur (by fusion), 6.05 per cent., sulfur (by evolution), 6.02 per cent., confirmed by duplicate.

The water-soluble was 2.15 per cent. The sulfur in this was 0.949 per cent., equivalent to 2.14 per cent. calcium sulfide. This seems to show that only a small part of the calcium sulfide, and nothing else, was dissolved out by boiling with water for some time. By dissolving in hydrochloric acid (1.12) I found approximately 58 per cent. to be soluble and 42 per cent. insoluble. The soluble part consists of about 24 parts of iron in minute particles and 34 parts of slag. The insoluble part consists of about 40 parts of titanium carbide, nitride, etc., and 2 parts of an almost insoluble silicate showing transparent colorless sand-like grains under the microscope.

Partly by direct determination and partly by calculation from the analysis, I have arrived at the following figures. The iron in the salamander was analyzed on the sample of 7½ gm. which remained on the 100-mesh sieve. It contains silicon, 1.39 per cent.; sulfur, 0.071 per cent.; total carbon, 1.57 per cent., confirmed by duplicate.

The slag, figured out as best it could be done, is as follows:

|                      | PER CENT. |                   | PER CENT. |
|----------------------|-----------|-------------------|-----------|
| Silica.....          | 26.77     | Potassa.....      | 0.52      |
| Alumina.....         | 11.79     | Soda.....         | 0.70      |
| Lime.....            | 18.22     | Titanic acid..... | 0.21      |
| Magnesia.....        | 6.46      |                   |           |
| Calcium sulfide..... | 35.33     |                   | 100.00    |
|                      |           | Sulfur.....       | 15.70     |

The titanic acid soluble in hydrochloric acid (1.12) is figured in the slag. It is surprisingly low. The insoluble carbide and nitride residue has the following composition:

|                                      | PER CENT. |                          | PER CENT. |
|--------------------------------------|-----------|--------------------------|-----------|
| Titanium.....                        | 67.88     | Nitrogen.....            | 8.66      |
| Iron.....                            | 0.55      | Silica and silicate..... | 11.60     |
| Carbon (combined and graphitic)..... | 11.24     |                          |           |
|                                      |           |                          | 99.93     |

The insoluble silicate, which in one case amounted to as much as 2.67 per cent. of the total, was analyzed with the following result:

|               | PER CENT. |
|---------------|-----------|
| Silica.....   | 44.91     |
| Alumina.....  | 30.71     |
| Lime.....     | 14.61     |
| Magnesia..... | 9.00      |
|               | <hr/>     |
|               | 99.23     |

In reply to a letter making further inquiry, Mr. Shimer says: "The sulfur in the salamander slag is far higher than anything that I have ever found in furnace slag, though I understand that such slags are usually much higher in sulfur than the regular blast-furnace slag. The thought occurred to me that some of the sulfur might exist as titanium sulfide, but a determination showed that this is not the case. That it occurs in the slag only is also shown by the fact that the fusion sulfur and evolution sulfur agree closely.

"As to the  $TiO_2$  in the slag, it is possible, as you suggest, that it remained insoluble in the hydrochloric acid and appears with the titanium in the insoluble residue. Remembering the very unusually high sulfur in the slag and the presence of carbon and nitrogen in the titanic residue, it seems to me quite possible that the slag may really be quite low in  $TiO_2$ ."

The material, therefore, is undoubtedly a mixture of blast-furnace slag, exceptionally high in sulfur, iron, free graphite, and a mixture of titanium carbide and nitride in about equal quantities; which of the nitrides has not been determined. It seems probable that the nitride consists of a mixture of about equal parts of  $Ti_2N_2$  and  $Ti_3N_2$ . The excess of sulfur leads one to expect the presence of titanium sulfide, but Mr. Shimer states that none was present and that the sulfur undoubtedly exists as calcium sulfide. Experience has demonstrated that slags containing 9 per cent. of calcium sulfide are anything but fluid, and that no furnace can be operated with a slag of such a sulfur content as is shown by the above analysis. Not having determined the sulfur contents of slags found in furnace salamanders, nor having seen an analysis published, I wrote to several furnace managers asking for information as to their sulfur contents. All replied that they had never analyzed nor seen analyses of such slags. Mr. Geo. Collard, general manager of the Shenango Furnace Co., subsequently analyzed slag from a salamander from a furnace operated on Lake ores and Connellsville coke but found no excess of sulfur.

From the information at hand, I was unable to decide whether, if the material caused the dirty hearth, the trouble arose from the presence of the calcium sulfide or from the titanium compounds. The melting point of calcium sulfide has been determined to be above  $1700^\circ C.$  ( $3200^\circ F.$ ) while the melting point of the titanium compounds, obtained by dissolving the slag and iron from them by hydrochloric acid, and separating the graphite as well as possible by decanting the lighter substances, could not be determined.

During casting, pieces of salamander were placed in the iron runner between the dam and skimmer. They floated on the iron and became mushy, but did not become fluid enough to spread over the surface of the pool of iron. A piece of titaniferous cinder and a piece of salamander were clayed to the bottom of the cinder trough. The cinder melted almost completely while one flush of cinder ran over it; the salamander was melted to the same extent after two and one-half flushes ran over it.

*Location in Furnace of Salamander-forming Material.*—The following investigation was made to determine the probable location of material forming the salamander in the furnace hearth, while the furnace was producing iron, and to determine the result arising from the introduction into the furnace hearth of substances that should liquidate the calcium sulfide or oxidize the titanium compounds, or both.

The material to be treated was placed in crucibles made from carbon electrodes, which were then placed in a furnace similar to a crucible-steel pot furnace, using blast. Coke fuel was used. A quantity of titaniferous cinder, iron borings, and salamander was crushed, carefully mixed, and sampled, and the sulfur content of each determined, as were the  $TiO_2$  in the cinder and the titanium in the iron and salamander. The crucibles were kept covered during the melt to prevent oxidation. The mixtures were melted as rapidly as possible and, after melting, were held in the furnace 2 hr., at approximately hearth temperature, then withdrawn, cooled in the crucible, and examined. The sulfur and titanium content of the iron and the sulfur and titanic oxide of the slag were determined. Melts Nos. 1 and 3 were lost, and reported under other numbers. The analyses were made by Mr. Wm. V. Knowles of the Titanium Alloy Mfg. Co. They are as follows:

|                           | Sample<br>No. 9<br>2A Slag | Sample<br>No. 10<br>4A Iron | Sample<br>No. 11<br>4A Slag | Sample<br>No. 12<br>No. 5<br>Iron | Sample<br>No. 13<br>No. 5<br>Slag | Sample<br>No. 14<br>No. 6<br>Iron | Sample<br>No. 15<br>No. 6<br>Slag |
|---------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Analysis No.....          | 2016-A                     | 2017                        | 2017-A                      | 2018                              | 2018-A                            | 2019                              | 2019-A                            |
| Titanium, per cent.....   |                            | 0.095                       |                             | 0.074                             |                                   | 0.092                             |                                   |
| Titanium oxide, per cent. | 6.48                       |                             | 5.06                        |                                   | 5.16                              |                                   | 5.46                              |
| Sulfur, per cent.....     | 2.29                       | 0.122                       | 2.18                        | 0.085                             | 1.74                              | 0.195                             | 2.53                              |

|                                  | Sample<br>No. 1<br>Cast<br>Iron | Sample<br>No. 2<br>Slag<br>FEB | Sample<br>No. 3<br>Sala-<br>mander | Sample<br>No. 4<br>Iron Bor-<br>ings from<br>No. 2 | Sample<br>No. 5<br>Slag<br>from<br>No. 2 | Sample<br>No. 6<br>Iron Bor-<br>ings from<br>No. 4 | Sample<br>No. 7<br>Slag<br>from<br>No. 4 | Sample<br>No. 8<br>2A Iron |
|----------------------------------|---------------------------------|--------------------------------|------------------------------------|--|--|--|--|----------------------------|
| Titanium, per cent.              | 0.302                           |                                | 25.29                              | 0.170  |  | 0.323  |  | 0.236                      |
| Titanium oxide, per<br>cent..... |                                 | 5.77                           |                                    |  | 6.58                                     |  | 7.69                                     |                            |
| Sulfur, per cent ...             | 0.200                           | 1.39                           | 6.53                               | 0.058  | 2.13                                     | 0.138  | 2.43                                     | 0.076                      |

*Experiment 2.*—In the second experiment, 40 gm. of salamander were placed on the bottom of the crucible and covered with 10 gm. of sodium carbonate and then with 250 gm. of cinder, mixed with 500 gm. of iron borings. The iron was in a solid button on the bottom of the crucible; there were no iron shot through the slag, and a small portion of the salamander was found attached to the bottom and sides of the iron button. The slag was crystalline and had a high  $\text{TiO}_2$  appearance. Crystals of titanium carbide and nitride could not be determined in the slag next above the iron, or through it. The titanium in the iron was reduced to 0.17 per cent., and the sulfur to 0.058 per cent.; the  $\text{TiO}_2$  in the slag increased to 6.58 per cent. and the sulfur to 2.13 per cent. If the titanium removed from the iron was oxidized and none of the titanium carbide or nitride of the salamander was oxidized, the  $\text{TiO}_2$  in the slag should have been 5.57 per cent., indicating an oxidation of 16.76 per cent. of the titanium contained in the salamander. The sulfur of the slag, if it contained all the sulfur originally in the salamander and that removed from the iron, would have been 2.43 per cent. The greater part, but not all of it, was, therefore, liquidated and absorbed.

*Experiment 4.*—In this experiment, 40 gm. of salamander were placed on the bottom of the crucible and covered with 20 gm. of magnetic-iron ore containing 90 per cent. of magnetic oxide, and over this was placed 500 gm. of iron borings mixed with 250 gm. of slag. The salamander all left the bottom of the crucible. Two small particles, the size of a large pinhead, were noted on the side of the iron button. There were some iron shot through the slag immediately over the button and the slag was crystalline, darker than No. 2, but the color did not indicate the presence of iron oxide. An examination with a microscope showed what were thought to be crystals of titanium carbide and nitride evenly distributed through it. The titanium in the button was 0.323 per cent., the sulfur 0.138 per cent.; in the slag, the  $\text{TiO}_2$  increased to 7.69 per cent. and the sulfur to 2.43 per cent. The expected  $\text{TiO}_2$  in the slag was 5.24 per cent. if there was none oxidized from the salamander; the sulfur, if it contained all that in the salamander, 2.31 per cent., indicated an oxidation of 28.40 per cent. of the titanium content of the salamander, and a complete absorption of the sulfur.

*Experiment 2-A.*—The 40 gm. of salamander placed on the bottom of the crucible were covered with 20 gm. of pyrolusite of unknown composition, then with 500 gm. of iron borings mixed with 250 gm. of cinder. The result was that the salamander floated from the bottom of the crucible; slightly more of it than in experiment 4 was found attached to the side of the iron button and there were no iron shot. The slag had a decided manganese color. Examination with a microscope showed what were probably titanium carbide and nitride crystals in the slag next above the iron, and possibly some diffused throughout it. In the iron there was 0.076 per

cent. of sulfur; in the slag, 2.29 per cent. There was 0.236 per cent. of titanium in the iron and 6.48 per cent. of  $\text{TiO}_2$  in the slag. If all the sulfur entered the slag, 2.29 per cent. was expected; if no titanium was oxidized from the salamander, 5.18 per cent.  $\text{TiO}_2$  was expected, indicating complete absorption of the sulfur by the slag, and the oxidation of 22.03 per cent. of the titanium content of the salamander.

*Experiment 4-A.*—The 40 gm. of salamander were placed on the bottom of the crucible and covered with 20 gm. of fluorspar, and then with 500 gm. of iron borings mixed with 250 gm. of cinder. As a result, the salamander remained on the bottom of the crucible; there were no iron shot, and the cinder was dense and crystalline. Examination with a microscope did not indicate the presence of titanium carbide and nitride crystals in the cinder, on top of the iron, or through it. The iron button was so hard on the bottom next to the layer of salamander that it was difficult to drill, but the upper portion was soft. There was 0.095 per cent. titanium in the iron and 0.122 per cent. sulfur. The  $\text{TiO}_2$  in the slag showed 5.06 per cent., the sulfur 2.18 per cent. The expected sulfur, if all was dissolved in the slag, was 2.98 per cent.; the expected  $\text{TiO}_2$ , 5.23 per cent., thus indicating practically complete absorption of the sulfur, but no oxidation of the titanium content of the salamander.

*Experiment 5.*—The 40 gm. of salamander were extracted with hydrochloric acid 1.12 specific gravity. Hydrofluoric acid was added to dissolve the  $\text{SiO}_2$ , which had gelatinized, filtered, and washed. This removed all of the sulfur and iron and almost all of the slag, leaving the titanium carbide and nitride, as shown by Mr. Shimer's analysis. The 50 gm. of iron borings placed on the bottom of the crucible were covered by the extracted salamander, then with 450 gm. of iron mixed with 250 gm. of slag. The result showed no salamander material on the bottom or sides of the iron button and no iron shot. Examination of the cinder with a microscope indicated the probable presence of titanium carbide and nitride in the lower portion of the slag. The cinder contained 5.16 per cent.  $\text{TiO}_2$  and 1.74 per cent. sulfur. The expected  $\text{TiO}_2$ , if the titanium removed from the iron was oxidized, was 6.45 per cent.; the expected sulfur was 1.60 per cent. The  $\text{TiO}_2$  content of the slag was less than that originally contained in the cinder used, indicating either a reduction of titanium and its solution in the cinder or an error in determination. The sulfur reported in the slag was slightly in excess of the total sulfur charged.

*Experiment 6.*—Over 250 gm. of borings placed on the bottom of the crucible there were poured 200 gm. of salamander, which were covered with 250 gm. of iron borings, mixed with 250 gm. of slag. This time the iron settled to the bottom, except for rather more iron shot than were found in any of the other melts. There was no salamander on the bottom or sides of the iron button, the salamander material being found next

above the iron. This looked to be slightly diluted with slag. The titanium carbide and nitride crystals gradually decreased toward the top, when they seemed to be entirely absent. The titanium in the iron was reduced to 0.092 per cent.; the sulfur was 0.195 per cent. The slag contained 4.46 per cent.  $\text{TiO}_2$  and 2.53 per cent. sulfur. The expected  $\text{TiO}_2$  content of the slag, if that removed from the iron was oxidized, was 4.74 per cent. The sulfur content, if it contained all the sulfur of the salamander, was 4.84 per cent., indicating an oxidation of 2.82 per cent. of the titanium content of the salamander, and a removal of about one-third of its sulfur content.

The estimates of titanium oxidized and sulfur fluxed or liquidated were based on the assumption that all the iron charged, plus 20 per cent. of the weight of the salamander, the iron in the magnetic ore used, and half the manganese charged were found in the iron buttons. The slag was assumed to contain the cinder charged, 41 per cent. of the weight of the salamander, one-half of the manganese as  $\text{MnO}$ , and all the slag-making material of the fluxes. The slag samples were in all cases taken from the top of the layer of slag, when they should have been free from titanium carbide and nitride if these materials are not dissolved in or absorbed by blast-furnace slag. The iron content of the salamander was determined by analyses; the slag content partly by analyses and partly estimated; to the weight found as above, was added the increased  $\text{TiO}_2$  and sulfur contents.

Although the investigation reported above was rather crude, I think I am safe in assuming that the following conclusions are reasonably safe deductions.

1. The salamander-forming material floated on the iron bath in the furnace hearth, forming a layer between it and the cinder, and was not a salamander until the furnace was blown out. This is demonstrated by its floating on the iron in the runner and by its rising to the top of the iron in five out of six of the experiments.

2. The freeing of the salamander from sulfur does not cause the absorption of titanium by the iron. (I had rather expected the freeing of the material from sulfur would cause the titanium compounds to settle to the iron layer and be absorbed by it.) The titanium of the iron was reduced in all, except one, of the experiments and there was clearly no absorption of it by the iron.

3. The removal of the sulfur from the salamander causes the titanium compounds to be absorbed by or diffused through the cinder lying above it. This conclusion is by no means proved, it is based on the disappearance of the greater part of the titanium compounds and the presence of titanium carbide and nitride crystals through the slag.

To my knowledge, the presence of titanium carbide or nitride in blast-furnace slag has never been reported, but there are several facts which

make its presence probable. First, the analyses of slags containing  $\text{TiO}_2$ , when the titanium content is figured to be present as  $\text{TiO}_2$ , generally foot in excess of 100 per cent. Second, these slags are never entirely soluble in hydrochloric acid or mixtures of hydrochloric and sulfuric acids, but are readily soluble in a mixture of hydrochloric, sulfuric, and nitric acids. Third, treatment of the residue from solution with hydrochloric and sulfuric acids with nitric acid, freed from nitrous oxides, results in the production of brown fumes of nitrous oxides. The direct determination of titanium in the presence of  $\text{TiO}_2$  is difficult, if not impossible. A determination, however, of combined carbon and nitrogen in the slag portion insoluble in hydrochloric acid would demonstrate the presence or absence of the carbide and nitride, and, without doubt, the correct estimation of the carbide. The titanium combined as nitride could only be estimated after determining which of the numerous nitrides were present. The analyses on which these conclusions are based were made on the assumption that all the  $\text{TiO}_2$  present in the slags was soluble in mixtures of hydrochloric and sulfuric acids, or if not all soluble, the amounts soluble were relatively the same in all of the analyses reported.

4. The titanium compounds, when present in the hearth of a furnace, can be easily removed by introducing materials that will liquidate the calcium sulfide and oxidize the titanium compounds; this is demonstrated by the results of experiments 2, 4, and 2-A. The use of iron oxide, either fine ore or scale, fed into the tuyeres while casting or immediately after casting, offers a convenient means to the end desired. At first thought, the introduction of iron oxide through the tuyeres might seem objectionable, owing to its reducing hearth temperature, but where it is reduced by the oxidation of titanium carbide, there is a gain instead of a loss of heat. In experiment 4, the heat produced by the titanium carbide oxidized was one and three-fourths times the heat necessary for the reduction of all the iron in the oxide used and the fusion of the reduced iron. It is probable that this reaction explains the observed excessive hearth temperature, while we were using titaniferous ores, owing to unreduced iron oxide which was carried into the hearth, being reduced by titanium instead of by solid carbon. The excess hearth temperature also explains the lower sulfur content of iron made while using titaniferous ore. The cause of the presence of the excess of calcium sulfide and the titanium carbide and nitride remains unsolved. It has occurred to me that excess calcium sulfide may be as much a cause of all dirty-hearth phenomena as is fine fuel, to which I have heretofore attributed it, and that, therefore, it may not be as uncommon as it at first appears. All experienced furnace managers have gone through periods of persistent dirty hearths. The presence of the titanium compounds was due either to separation of them from the cinder in which they were dissolved and their settling through it, owing

to their being of higher specific gravity, or more probably to their exuding from iron which was supersaturated with them.

Since the above notes were made, Mr. Porter W. Shimer has separated both titanium carbide and titanium nitride from a sample of charcoal blast-furnace cinder made about 1854 in a furnace operated on an ore mixture containing approximately 18 per cent. of  $\text{TiO}_2$ . Analyses of this cinder show it to contain from 23 to 25 per cent. of  $\text{TiO}_2$ , all of the titanium contents being figured as  $\text{TiO}_2$ . In a sample of coke-furnace cinder containing 9 per cent. of  $\text{TiO}_2$ , when all of the titanium contents was figured to  $\text{TiO}_2$ , he has separated titanium carbide but was unable to find any titanium nitride.

### The Wisconsin Zinc District

Discussion of the paper of W. F. BOERICKE and T. H. GARNETT, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1213.

F. J. DE WILDE, Galena, Ill. (written discussion\*).—As it is impossible to spare the time for a lengthy discussion of this excellent paper, I am dwelling only on points where either the information is not clear or opinion differs radically from that of the authors.

On page 1218, relative to oil rock, the authors state that the presence of oil rock is always taken as a favorable indication of proximity to ore. As thick, highly carbonaceous, oil rock has been found quite often in isolated patches outside of the district proper, the mere presence of oil rock is not always an indication of the propinquity to ore deposits.

Regarding glass rock, I agree with the authors, that, generally speaking, sphalerite in the glass rock is spotty; however, they fail to mention that nearly all mines contain more or less ore in the glass rock, the usual location being near the toe of the pitch.

On page 1220, they say that disseminated deposits are only found in, or close to, the oil rock. To refute this statement, I refer them to a typical disseminated deposit situated at the Adam and Eve shaft of the Frontier Mining Co. This deposit is located in the central horizon of the Galena dolomite, that is, in those sedimentaries containing flint nodules. Perfect crystals of sphalerite are found disseminated throughout the rock, and are commonly known by the miners as strawberry jack. I believe all top runs, or upper deposits as described above, should be classed as disseminated; physically the ore makes its occurrence in just such a manner.

Honeycomb deposits are those that have been formed through changes in the circulation and solution of the underground waters acting upon the sheet deposits. Proof of this is the presence of remaining typical sheets within the deposit; often deposits are part sheet and part honeycomb. It might be advisable to mention that sheet and disseminated deposits

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have been observed as adjacent deposits, either in higher or lower horizons, and the one may lead to the discovery of the other.

On page 1221, it is stated that pillars are frequently left in unpayable spots. By this, I assume the authors mean either rock barren of sphalerite, or so highly impregnated with iron sulfide that the mining of it would materially lower the grade of the concentrates.

Chamberlain's illustration of a typical sheet cross-section showing the two pitches is an exception rather than the rule; I have yet to see a typical double pitch deposit.

The Coker mines, on page 1222, furnish the best illustration of a flat sheet running off at right angles to the strike of the pitch. This occurrence is also true at the Blewett mine of the Blewett Mining Co. Here the flat, which is located midway between oil rock and capping, makes a right angle turn to the strike of the pitch, and carries a large sheet of jack for about 50 ft. (15 m.) the width being about 25 feet.

Extensions to orebodies, as illustrated by the Lucky Twelve mine, could also be illustrated by deposits found in Calvert ground, of the Frontier Mining Co. Four times the Calvert mine was thought to have been worked out, only to come to life again by finding another deposit separated from the last orebody by a stretch of barren limestone.

A paragraph, on page 1227, states that when a good hole has been found, to develop the orebody the usual procedure is to cross-cut the range first, in order to determine the width of the orebody and the direction of the pitch. This statement is misleading as the direction of cross-cutting is unknown. I think we try to cross-cut the range to determine the strike of the orebody, but it is seldom that this occurs as most deposits are too irregular in height, width, direction, etc., to follow their course by this method.

On page 1229, the authors refer to the location of pillars as determined largely by the character and shape of the orebody, etc. At the mines of the Frontier and Burr mining companies, pillars are left as often as it is deemed necessary to support the cap rock, regardless of whether they contain much or little ore, although barren ground or that containing a high percentage of marcasite is favored as much as possible, all things considered. Where the cap rock shows numerous crevices, pillars must necessarily be left more frequently to support the broken area. Often faulty cap rock delays operations for days, as it must be taken down, trimmed, and arched to the succeeding layer of rock above.

*Shafts and Hoistings.*—Buckets, designated as cans and varying from 1000 to 1200 lb. in capacity, are used more extensively than cars and cages; not that it is ultimately less expensive to do so but because the first cost of installation is considerably less. They are more elastic in their application to small mines. Balanced hoisting with cars and cages, as operated by the Mineral Point Zinc Co., no doubt is the cheapest and best method to use where the deposit is large.

*Breaking Ground.*—Air hammer drills mounted on columns are fast being discarded for the more easily hand held and more mobile Jack-hammer. With the Jackhammer, a drill man will drill more footage and, consequently, break more ground than with the mounted machine, as no time is lost in setting up and taking down a machine. Contractors prefer the Jackhammer. The consumption of air and the upkeep are less than with the mounted machine. The machines are best oiled by forcing oil into the air line under pressure, the operation being automatic.

*Ventilation.*—It is very seldom that a drill hole by itself will prove an efficient means for providing air to a mine heading. Blowers are used to force air into the mine workings and the larger the diameter of the hole the greater is the volume of pure air to mix with the vitiated atmosphere underground, thereby making the mine a desirable place for the men to work in, and resulting in more efficient labor. It is usual, where the workings are low and the ventilation consequently poor, to ream a 6 in. hole to 10 or 12 in. in diameter and then install a large blower to force air into the mine. Where a drill hole has been left without casing, it is seldom efficient as a means of ventilation. All drill holes should be cased from top to bottom, as often open flats will deflect the air and allow little air to arrive at the mine headings. It has been my experience that suction fans, in this district, have been uniformly unsuccessful.

*Haulage.*—It seems to me that the gasoline and storage-battery locomotives have been slighted by the authors and favoritism shown to the mule. The authors state that haulage costs when using mules are from 25c. to 35c. per ton-mile. This is excessively high when compared to mechanical haulage where the cost is seldom above 24c. per ton-mile with a limited tonnage. Where large tonnages are hauled, the average is about 16c. per ton-mile. When first used, the cost has been as low as 8c. per ton-mile. These figures include the cost of maintenance, repairs, oil, gasoline, and depreciation. The exhaust from gasoline locomotives vitiates the air considerably and it always takes some time for the men to become accustomed to the fumes. The mines must be kept well ventilated for good results.

*Concluding Remarks.*—The conclusions drawn regarding the life of the field seem to me to be slightly optimistic. I agree that there are still large areas remaining unexplored, but we do not know that these areas will prove as prolific in mines as those that have been prospected thoroughly in the past. Very few sheet deposits have been discovered during the past two years, which fact is causing grave concern among the larger operators. This is a serious problem and there is no doubt in the minds of most managers that only better prices for zinc ore will stimulate prospecting and make possible the exploitation of large deposits of low-grade ore.

The phenomenal rise in production during the past five years has been due almost entirely to high prices; and only high prices will spell a steady growth in production for the district.

# Forging Temperatures and Rate of Heating and Cooling of Large Ingots

Discussion of the paper of F. E. BASH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2869.

LAWFORD H. FRY, Burnham, Pa. (written discussion\*).—As a supplement to the information given by Mr. Bash, a diagram is submitted showing the results of a somewhat similar experiment carried out at the ordnance plant of the Standard Steel Works Co. In this case the ingot to be heated was a nickel-steel octagon ingot, weighing 14,700 lb. (6667 kg.). This ingot was to be forged into two 255-mm. howitzer jackets. A hole was bored half way of the length of the ingot, extending into the longitudinal axis, and a base-metal thermocouple inserted in this hole.

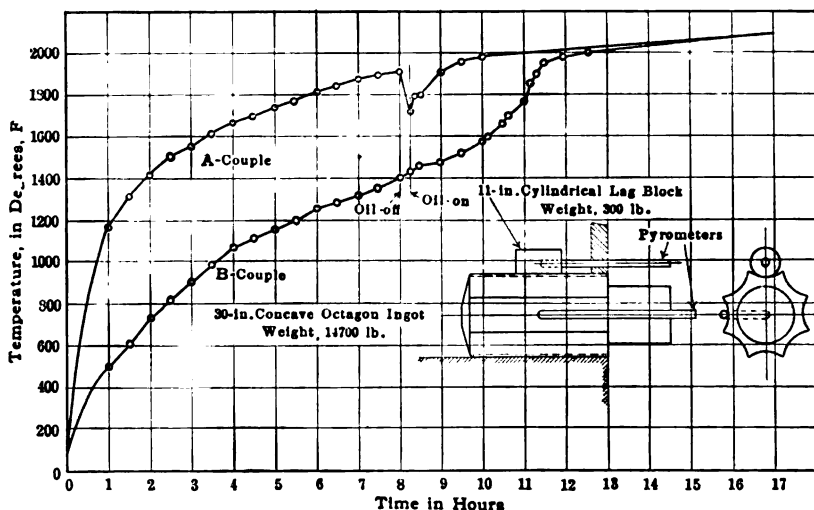


FIG. 1.—HEATING EXPERIMENT WITH 30-IN. CONCAVE OCTAGON INGOT N-85-B IN FORGE SHOP FURNACE.

In order to obtain the temperature of the exterior of the ingot, a similar couple was placed in the hole in a cylindrical lag block, 11 in. (28 cm.) in diameter, weighing 300 lb. This couple is the *A-couple* in the diagram, the couple in the ingot being the *B-couple*. The exterior or *A-couple* reached 2000°, which was the maximum temperature registered by the pyrometer in 10 hr., while the couple at the center of the ingot took approximately 21½ hr. longer to come to this temperature. The exterior temperature, measured by an optical pyrometer, was approximately 2100° at the end of 17 hr. The experiment was carried out in connection with the discussion of the proper time for heating large ingots for gun forgings and the results were presented to the Gun-Howitzer Club in September, 1918.

\* Received Sept. 30, 1919.

## Manufacture and Electrical Properties of Manganin

Discussion of the paper of F. E. BASH, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1717.

F. WEIMER,\* Washington, D. C. (written discussion†).—For electrical measuring instruments, especially those types that involve the Wheatstone bridge or potentiometer principle and standards of electrical resistance, there has been, for a considerable time, a need for better resistance materials. For a satisfactory resistance material, much depends on the purposes for which it is to be used. For potentiometers and Wheatstone bridges, such as are in more or less general use, and the more common forms of resistance standards, a good quality of manganin answers fairly well. However, it should not be presumed that manganin is considered ideal for the purpose, for in measuring instruments and resistance standards, there is still much to be desired. An experience of more than 10 years in the study of the resistance standards and resistance apparatus shows that manganin resistances change with time in a way that is very annoying and the maintenance of the unit of resistance to the desired accuracy requires an excessive amount of work or may be said to be practically impossible. The changes in resistance are generally most rapid and erratic in resistances of very low and very high values. In resistances of low value, the resistance material is often in the form of thin sheets so that the surface is large and usually more or less unprotected from the atmosphere, or the oil in the case of oil-immersed standards. In resistances of high value, the resistance material is in the form of fine wire and, therefore, the surface is large compared with the cross-section. In resistances of medium value, the surface is less, compared with the cross-section, or better protected, usually by a silk wrapping impregnated with shellac. This suggests that one of the difficulties with manganin is slow surface action or oxidation, even when an effort has been made to protect the surface from such action. However, the changes observed cannot all be accounted for on this basis. There are, presumably, also some internal changes in the resistance material even when it has been annealed. Further, the changes in manganin resistances seem to be more or less independent of its electrical properties. In other respects, too, manganin is not ideal.

What is desired is a material having an electrical resistance or resistivity that will remain constant with time to the highest possible degree; a high resistance to surface action or oxidation; high resistivity; a very small resistance-temperature coefficient; very small thermoelectromotive

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† Received Sept. 29, 1919.

force against copper; good mechanical properties, so that it can be easily drawn or rolled, silver soldered or brazed, and wound in coils even when in the form of very fine wire; and cost of producing which is not excessive. Of course no one material can possess all of these properties to the extent desired; one or more of them must be sacrificed to get more nearly what is desired of another. A good quality of manganin possesses most of these properties to a remarkable degree. However, other alloys may be found that possess many of these properties to a greater degree.

In a number of resistance standards the resistance material has the following composition: Copper, 84.2 per cent.; aluminum, 4.2 per cent.; manganese, 11.5 per cent.; nickel, trace; iron, trace. This, it will be observed, is similar to manganin except that the nickel is replaced by aluminum. In so far as the resistivity and temperature-resistance coefficient are concerned, this material is practically the equivalent of manganin. The thermoelectromotive force against copper is less than that of manganin against copper. The value we have found using different lots of the material is about 0.3 microvolt per degree centigrade, which is only about 0.1 as large as for the best of the manganin. This material is, therefore, considerably better than manganin in this respect, which is an important one where the resistance is of very low value. Mechanically, this material is considerably better than manganin. Our observations on the constancy of the resistance are not very conclusive, since during the past few years this work has not received the attention it would have received under normal conditions. However, the indications are that the standards in which this material was used are as reliable as those in which manganin was used. There is, therefore, every reason to think that this alloy constitutes a very promising field for investigation.

An alloy of gold and palladium (about 60 per cent. gold and 40 per cent. palladium) has fairly good electric properties and there is a possibility that for resistances made from extremely fine wire it may prove superior to any of the alloys that have been used for this purpose. At any rate, we would expect the surface action to be much less than for manganin or similar alloys.

For certain types of resistances, some consider an alloy of nickel and copper, which might be classed as constantan, as better than manganin. An investigation of this alloy from the standpoint of its resistance properties might lead to the development of a better material for use in the construction of high resistances and resistances to be used with alternating current.

The work done by Mr. Bash is of very great importance to all concerned in the use of resistance material and is, no doubt, of equal importance to those concerned in making other alloys of a definite and uniform composition. However, we should not presume that all that is

desired in the production of electrical resistance material has been done. There is need for similar work with other alloys and the development of new alloys which will possess some or all of the properties mentioned to a greater degree than does manganin. There is, therefore, plenty of room for more work along this line. Finally, the proof of the real quality of any of these alloys is the constancy of the resistances constructed from them; in the case of good alloys, this requires a series of measurements extending over several years.

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### Recent Improvements in Pyrometry

Discussion of the paper of R. P. BROWN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1979.

E. D. TILLYER,\* Southbridge, Mass. (written discussion†).—It is quite generally known that there is very little that is standard about a mercurial thermometer at temperatures above 212° F. (100° C.) because so many precautions must be taken—precautions that are rarely realized in practice—such as depth of immersion, aging, elastic fatigue, separation of mercury column, and accidental deformation from very slight excess temperature.

One cannot help wishing that Mr. Brown would dwell at greater length on the practical side of both radiation and optical pyrometry, both of which have great possibilities as commercial instruments. In the radiation pyrometer we have ideal conditions for a permanent instrument, no materials being exposed to excessive temperatures or subjected to contamination from the furnace fumes which may raise such havoc with an ordinary pyrometer. The development of a radiation pyrometer requires a thermocouple having a relatively high electromotive force but which need stand temperatures of only 200° F. or 300° F. instead of 1500 to 2000° F., which is required of even a base-metal couple. The galvanometer, if located near the thermocouple, does not need to have a high resistance as at such low temperatures no changes can occur in the thermocouple that will affect its resistance and, consequently, the indicated temperature.

The serious source of error is the lens or mirror, which images the furnace interior on the hot junction of the thermocouple; this must always have the same transmission, or reflection, and dirt and tarnish must be avoided. Another source of error in many instruments is the temperature of the cold junction, which heats up from radiation. However, there is no fundamental reason why the cold junction cannot be

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\* American Optical Co.

† Received Sept. 25, 1919.

carried to a position of constant temperature, as is done with the regular thermocouple pyrometers.

One physical defect of a radiation pyrometer is the absorption of the longer heat rays by varying amounts of water vapor in the atmosphere. Perhaps this could be overcome by using selective absorption screens cutting out the rays absorbed by water vapor. Another physical defect of a radiation pyrometer, and also of the optical pyrometer, is that it indicates the radiation temperature of the object on which it is focused. This would seldom be an objection, however, as the most that is desired is to reproduce temperatures; if it were desired to obtain true temperatures, the black-body condition could be obtained for a small part of the furnace by simply inserting a heat-resisting tube for a considerable distance and focusing the pyrometer on the inside end.

The optical pyrometer requires, in all present forms, that the observer look through it and not at it. Until someone overcomes this practical defect, one of the best forms of instruments for higher temperature pyrometry is probably barred out.

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### Effect of Time and Low Temperature on Physical Properties of Medium-carbon Steel

Discussion of the paper of G. A. REINHARDT and H. L. CUTLER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1091.

GEO. F. COMSTOCK,\* Niagara Falls, N. Y. (written discussion†).—On studying this paper it has occurred to the writer that possibly it was the drilling of the test cores that produced the strains which affected injuriously the authors' unrested bars. They found that the machining had only a slight effect, but did they also investigate the effect of the drilling by trying rest applied to the bloom sections before the cores were drilled from them? The writer has heard of a similar effect of rest after machining on test bars from castings, and it would seem more reasonable that the ductility was increased because the rests relieved strains produced in drilling the test cores from the blooms, than because of any peculiar combination of solidification and rolling strains in the blooms which did not exist in smaller billets.

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\* Metallurgical Engineer, Titanium Alloy Mfg. Co.      † Received Sept. 29, 1919.

## Oxygen in Cast Iron and its Application

Discussion of the paper of WILFORD L. STORK, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 951.

GEO. F. COMSTOCK,\* Niagara Falls, N. Y. (written discussion†).—A study of this paper raises a question on which it is hoped Mr. Stork will throw more light; that is, why does an oxygen content generated on poor melting conditions have a deleterious effect on the properties of the iron, while an oxygen content generated by the oxidation of steel scrap in the cupola is beneficial to the strength and chilling ability? In each case the oxygen is absorbed at the same time and place in the process of melting and it is by no means clear why the superiority of semisteel should be assigned solely to its oxygen absorption, when oxygen absorbed without the steel addition is admitted to be injurious. It is not apparent why oxygen caused to be absorbed by the steel addition should not produce the effects of burning, sluggishness, slag inclusions, gas occlusions, etc., the same as oxygen absorbed by the iron in the cupola for any other reason, and it would seem that other factors to which he has not given sufficient emphasis must enter into the author's results. To an impartial reader of this paper, who was most favorably inclined toward J. E. Johnson, Jr.'s theory of the improvement of cast iron by oxygen, the discrepancy in the author's reasoning or statements is difficult to accept, and it is hoped that an explanation will appear in the final discussion.

## Application of Pyrometry to the Ceramic Industries

Discussion of the paper of C. B. THWING, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2139.

FRANCIS T. OWENS,‡ Watsontown, Pa. (written discussion§).—In the second paragraph, Dr. Thwing mentions the various stages through which clay ware must pass but he does not analyze the third stage, oxidation, sufficiently. There are two elements to dispose of in a great many of the shales that must be burned; these elements are carbon and sulfur. Dr. Thwing speaks of the carbon, but intimates that it is safe to have a temperature of 800° C., which we find to be rather dangerous on a great many shales. With one shale that we handle, we cannot go above 535° C. until we have passed this particular stage. At 800° C. the sulfur will begin to pass off and it is very necessary that plenty of air be ad-

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‡ Received Sept. 29, 1919.

§ Received Sept. 18, 1919.

mitted at this time and a very even temperature maintained. I realize fully that this paper is not meant to be much more than a suggestion in the use of pyrometers in burning of clay wares, but lest some one be led astray, I call attention to the above results of our practice.

Our experience with cones is that if a cone is brought to a temperature near its fusion point and is then allowed to cool off  $80^{\circ}$  to  $100^{\circ}$  F., the cone will show an error of from  $30^{\circ}$  to  $100^{\circ}$  in its fusion point. We have not discovered just why this is, but have had this experience in two or three instances. For that reason, cones are not a sure guide and, while we use them, we would not think of attempting to burn a kiln without pyrometers.

Dr. Thwing speaks of the necessity for study of the information obtained when using pyrometers; this is one of the points that should be emphasized greatly. It is not enough to have records to look at, the heat records of each kiln should be traced on cross-section paper. A study of the records will soon show that no two kilns act in exactly the same way. Charts should be drawn of those burns showing the best results, then a composite chart should be made from these various charts; in this way a burning guide that will insure good results throughout the entire burning plant may be obtained.

The writer strongly advises the use of a recording pyrometer both at the hot end and the cold end of the dryer. We have found that where wares were difficult to dry, the trouble is due chiefly to conditions in the dryer that we were not aware of until we began to make records for the entire 24 hr. A recording mercury thermometer will do the work nicely in a dryer, but, as every one understands, is not adapted for kilns.

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### Annealing of Glass

Discussion of the paper of A. Q. TOOL and J. VALASEK, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1945.

E. D. WILLIAMSON,\* Washington, D. C. (written discussion†).—The paper is interesting and suggestive and the work described should be carried to completion, as it presents points of interest quite apart from the immediate application in glass manufacture. It ought to help, for instance, in throwing light on the chemical nature of glasses and on all questions of viscous flow.

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† Received Sept. 18, 1919.

In practice, we have found that it is much safer to use temperatures some 40° or 50° below those given in the authors' table, especially where large muffles, which have considerable lag, are used. It is exceedingly difficult in many cases to regulate the initial rate of cooling closely and this trouble can be completely avoided by working at a point where the strain takes several hours to vanish.

Results based on Maxwell's equation are of doubtful significance as this equation is made up on a definite assumption as regards the relation of stress to strain, which does not hold in the case under consideration.

A point that is insufficiently emphasized is that the exceedingly small conductivity of glass causes a large temperature difference between the outside and the center while heating or cooling. This means that for larger pieces the initial rate of cooling must not only be less but the point at which the cooling is speeded up must be lower.

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### Determining Gases in Steel and the Deoxidation of Steel

Discussion of the paper of J. R. CAIN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1309.

ALLERTON S. CUSHMAN, Middletown, Ohio (written discussion\*).—This subject is one to which I have given much thought and study and which I have frequently discussed informally with Mr. Cain and others. I have long been convinced that the gaseous elements, either combined or entrained (occluded), in steel play a much more important role than is ordinarily admitted. This is probably due to the difficulties encountered in the accurate quantitative estimation of gases, some of which Mr. Cain has referred to, as well as to the fact that, considered from the weight-percentage basis, gas content is measurable only in hundredths or even thousandths of 1 per cent. Volumetrically, however, the results obtained by modern research are startling, to say the least. Baraduc-Müller,<sup>1</sup> as cited by Mr. Cain, pumped out of 1000-lb. ingots of basic Bessemer steel 2100 l. of gas, or about 75 cu. ft., at normal temperature and pressure, per ton of steel. In other words, we are to understand that Bessemer steel normally carries about fifteen times its own volume of gas. According to Baraduc-Müller's table of results, which is given herewith, carbon monoxide, nitrogen, and hydrogen are important constituents of Bessemer steel, the latter gas being undoubtedly formed by the

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\*Received Sept. 19, 1919.

<sup>1</sup>Iron and Steel Inst., *Carnegie Schol. Mem.* (1914) 6, 216.

decomposition of the moisture water in the atmosphere during the process of blowing.

|                      | Per Gross Volume,<br>Liters | Per Cent. | Per Ton of Steel,<br>Liters |
|----------------------|-----------------------------|-----------|-----------------------------|
| Carbon dioxide.....  | 42.2                        | 3.6       | 76.7                        |
| Oxygen.....          | 10.6                        | 0.9       | 19.3                        |
| Carbon monoxide..... | 352.2                       | 30.5      | 640.3                       |
| Hydrogen.....        | 604.3                       | 52.2      | 1098.7                      |
| Methane.....         | 2.4                         | 0.2       | 4.3                         |
| Nitrogen.....        | 147.7                       | 12.7      | 268.5                       |

Baraduc-Müller also says:<sup>2</sup>

In the case of hydrogen, it is seen that the 5150 cu. m. of air injected into the converter contained, owing to the 5.672 gm. of water per cu. m., 29,210.8 gm. of water capable of yielding, by complete dissociation, 3245.6 gm. of hydrogen, corresponding, at about 15° and under a pressure of 760 mm., with a volume of 36,058.6 liters.

Now with 1098.7 l. of hydrogen given per ton of steel, measured at the ordinary temperature, the entire cast must have contained, at a given moment, 13,860.3 l. of hydrogen. It results, therefore, that the maximum amount of hydrogen fixed, at any rate momentarily, by the steel in some form or other, dissolved or in combination, must have been

$$\frac{13,860.5 \times 100}{36,058} = 38.5 \text{ per cent.}$$

of the total volume of the available hydrogen.

This throws an interesting insight into the extreme solubility of the gases, and in particular of the hydrogen, in liquid steel at a high temperature. It remains to ascertain if these gases are actually in solution or in combination, and also what is left of these gases in the steels at the moment of solidification in the ordinary condition of manufacture.

Austin, whose work has also been referred to by Mr. Cain, investigated the gas content of samples of mild open-hearth steel and obtained about 1 c.c. of gas per gm. of steel, equivalent to about 35 cu. ft. per ton. The analysis of Austin's gas is as follows: Carbon dioxide, 7.7 per cent.; carbon monoxide, 18.4 per cent.; hydrogen, 59.1 per cent.; nitrogen, 14.8 per cent.

It is interesting to compare these results with those obtained by Baraduc-Müller who cooled basic Bessemer steel in a vacuum, and obtained 75 cu. ft. of gas per ton of metal, while Austin obtained in the case of the open-hearth steel 35 cu. ft. per ton; or approximately 7.5 cu. ft. of gas to each cubic foot of metal. In the first case, however, it is presum-

<sup>2</sup> *Op. cit.*, 227.

able that some part of the gas collected would have escaped into the air, had it been allowed to cool in a normal manner: Austin, however, started with a finished bar of cold steel, and it is difficult to escape the conclusion that all the gas evolved was actually held in some form or another in the body of the metal. That the gas was present in blowholes, is impossible, when we consider the volume relations that follow from his experiments. Austin collected gas which, calculated to a tonnage basis, amounted, as has been shown, to about 35 cu. ft. per ton of metal. This is a most extraordinary conclusion and one that will perhaps be unwelcome information to many steel makers. Fortunately or unfortunately, however, depending on the point of view, there is quite a mass of evidence to show that commercial steels as made and sold contain up to ten times their volume of gas.

In 1871-74, Parry examined a large number of commercial steels by heating them in evacuated porcelain tubes, but he obtained such high yields of gas that no one would believe in the accuracy of his results. Later, Belloc, Boudouard, Baker, Charpy, and Goerens examined a number of steels and irons by heating in vacuum and obtained results which show that a wide variety of steels yield anywhere from six to ten volumes of gas per unit volume of metal. While many of these researches may be so open to criticism that general conclusions based on them should be conservative, they point in one direction, viz., that the gas content of steels is much higher than has been generally supposed, and introduces an important factor when the soundness and physical character of any given type of metal has to be studied.

The question as to whether the gaseous impurities that are combined with iron or solid impurities in the form of hydrides, nitrides, and carbonyl compounds are also removed by heating or melting steel and iron in vacuo, is still unanswered. Baker suggests that the most probable, and at the same time the simplest, explanation is that the gases are simply imprisoned in the pores of the steel, and when the steel is reheated in vacuo they diffuse out.

If the physical properties of steels of various types are affected by the nature and quantity of the occluded gases they contained, it seems fair to the writer to inquire whether it may not be true that these factors exert an important influence on the much discussed question of corrosion resistance in relation to the chemical constitution of iron and steel. The alleged good or bad effect of minute differences in the percentage composition in relation to carbon, manganese, sulfur, silicon, and especially copper, has been so much discussed by a great number of investigators that there is little left to be said or claimed in regard to the influence of these solid constituents. The effect of gas content has, however, been curiously overlooked in the discussion of corrosion problems heretofore, and yet it is probable that this one factor is the most important of all

with relation to all the commercial metals, no matter whether we are considering a steel sheet or a brass or bronze condenser tube.

Apparently steel partakes of the nature of a microscopic sponge capable of holding enormous quantities by volume of gas. We need more accurate information in regard to the effect of this gas content on the physical characteristics of steels, including comparative resistance to corrosion but one common-sense conclusion appears to stand out prominently, and that is that the highest purity as represented by the most efficient degasification is a consideration of the highest importance in the manufacture of all high-quality metals.

Mr. Cain has pointed out that the total gas content of steels subdivides into three separate classes. I think that this point should be thoroughly understood by all students of iron and steel, and in order to simplify our nomenclature I would suggest that we refer to alpha, beta, and gamma gas in all discussion of this subject. Alpha gas is simply the atmosphere contained in pockets, blowholes, pipes, and seams contained within the body of the metal. Beta gas is molecularly entrained or occluded in a state that is defined by physical chemistry as solid solution, or, in other words, it is held submicroscopically. Gamma gas is combined or fixed gas, as in oxides, nitrides, hydrides, and carbonyl compounds, which may be evenly dissolved in the metal or segregated in its structure.

We can now discuss the limitations of analytical and gas extraction methods as applied to metals. The Ledebur oxygen determination, as pointed out by Mr. Cain, determines all of the  $\alpha$  and  $\beta$  oxygen plus a part of the  $\gamma$ . Of course, any oxygen that may be present combined in non-reducible oxides, such as manganese oxide, is not determined by the method. Nevertheless, the Ledebur method yields very useful results in the control of deoxidation. The Allen method for nitrogen determines the  $\gamma$  nitrogen only and Mr. Cain suspects only a part of this; a new method for estimating total nitrogen is being worked out at the Bureau of Standards. It is to be hoped that if this method is too difficult and costly to be used in commercial control of degasification, it will at least yield data that will enable us to apply approximate corrections to the easily carried out Allen method. Practical everyday methods for the determination of carbon monoxide and total gas content would be of the greatest value to every steelworks research laboratory.

There are numerous problems connected with the relations of gases to steel that are not yet solved, and in regard to which there is little or no data available. If, for instance, steel is annealed in hydrogen at certain temperatures, it becomes soft and loses elasticity, while some authorities have claimed that hydrogen is absorbed or combined. If steel is pickled in acid, it absorbs hydrogen and becomes more brittle. No explanation of these divergent effects of hydrogen on steel has come to my attention as yet. Again, if steel is annealed in an atmosphere of ammonia gas, it

absorbs large quantities of nitrogen, and perhaps some hydrogen, while the material is rendered so brittle that it will break like glass. It is probable that in these experiments the gases associate themselves with the iron in either the  $\beta$  or  $\gamma$  conditions, or in a combination of these conditions.

In a long series of analyses for nitrogen carried out by the research department of The American Rolling Mill Co. by a method similar to that of Allen (which, as we have seen, determines only  $\gamma$  nitrogen), it has been observed that the nitrogen content of sheet steel that has been exposed to atmospheric corrosion for extended periods is invariably higher than in samples cut from the same sheets before exposure. This observation needs further confirmation and study, but if it is found to be a fact, it is certainly an extraordinary phenomenon, for it would then appear that iron is able to fix the nitrogen of the air, although in minute quantities at atmospheric temperatures and pressures. We have also collected data to show that Bessemer steels unusually high in  $\gamma$  nitrogen corrode with extraordinary rapidity. This may be the explanation of the well-known fact that, other things being equal, Bessemer steel suffers from corrosion to a much greater extent than open-hearth metal. In general, purity and efficient degasification are marked characteristics of rust-resisting metals. The collecting of the data on which the above general observations are based has not yet been concluded, so the data are reserved for publication and discussion on some future occasion.

J. S. UNGER,\* Pittsburgh, Pa. (written discussion †).—Those investigators who have tried to determine oxygen in steel by reduction in hydrogen or oxides in slags by solution methods have been surprised to find that at times their results showed great variations on the same samples. When one considers that oxygen and nitrogen are blown into the blast furnace and cupola and the reaction is intensely oxidizing, then powerfully reducing, it is difficult to understand how oxygen can be found in the pig iron, especially, in the presence of high percentages of such reducing agents as carbon, manganese, and silicon.

Carbon-monoxide gas is used as a cementing agent in certain processes. Steam passed over red-hot iron is decomposed leaving an atmosphere of hydrogen, while part of the oxygen unites with the iron to form a durable protective coating used in the arts. A mixture of natural gas and ammonia gas passed over red-hot iron is an extremely rapid cementing agent. It is probable that cyanides and nitrides are formed as intermediate products, but the end product is carburized steel. From these data, it would appear that gases are not necessarily injurious.

Results of tests showing pig iron containing more oxygen than Besse-

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\* Central Research Bureau.

† Received Oct. 6, 1919.

mer steel, which is made by a rapid oxidation process, have been published. Other tests show that electric steels made under reducing slags have a higher oxygen content than basic open-hearth steels made by oxidizing methods. Some published results show steels of superior quality but of higher nitrogen content than other steels containing less nitrogen. Such evidence is conflicting. Shimer and Kichline<sup>1</sup> showed how difficult it was to prepare over-oxidized steel. Iron and many other metals absorb gases at ordinary temperatures. Much has been written of the beneficial or injurious effects of the elements purposely added or found in steel. Much is based on opinion, not on facts.

It would appear to me that accurate data on the effects of various gases on the physical and mechanical properties of steel are of equal, if not greater, importance than the development of the best methods for the determination of gases. These data can only be obtained by making steels containing large amounts of oxygen, nitrogen, hydrogen, or their compounds, and making a careful study of their effect on the properties of the steel. If it is shown that a certain gas, or gases, has particularly beneficial or deleterious effects, then the best method of determining this gas should be studied.

### Thermoelectric Pyrometry

Discussion of the paper of P. D. FOOTE, T. R. HARRISON and C. O. FAIRCHILD, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153. September, 1919, p. 2631.

C. H. WILSON,\* New York, N. Y. (written discussion†).—On page 2680, under the heading Junction Box and Zone Box, the authors say, with reference to the zone-box principle of connections between primary couple, compensator couple, and copper leads, which method in its application to a single couple is shown in Fig. 34, that if this principle is adopted for a multiple installation, so as to save compensating leads, a selective switch may be (and the inference is that it must be) inserted between the zone box and the different couples, putting the switch at an inconvenient point, or putting up with some complicated interlacing of connections. Wilson-Maeulen Co. has employed the zone-box method extensively for several years and in none of the many multiple installations has either of those alternatives been resorted to. Instead there has been used a method of wiring with the switch at the indicator and involving no more complications than the junction-box method shown in

<sup>1</sup> *Trans.* (1913) 47, 436.

\* Wilson-Maeulen Co.

† Received Sept. 20, 1919.

Fig. 32. A diagram of this method is given herewith. The preference between the zone box and the junction box is not of principle but is dependent on relative location of furnaces, indicator, and cold-junction point.

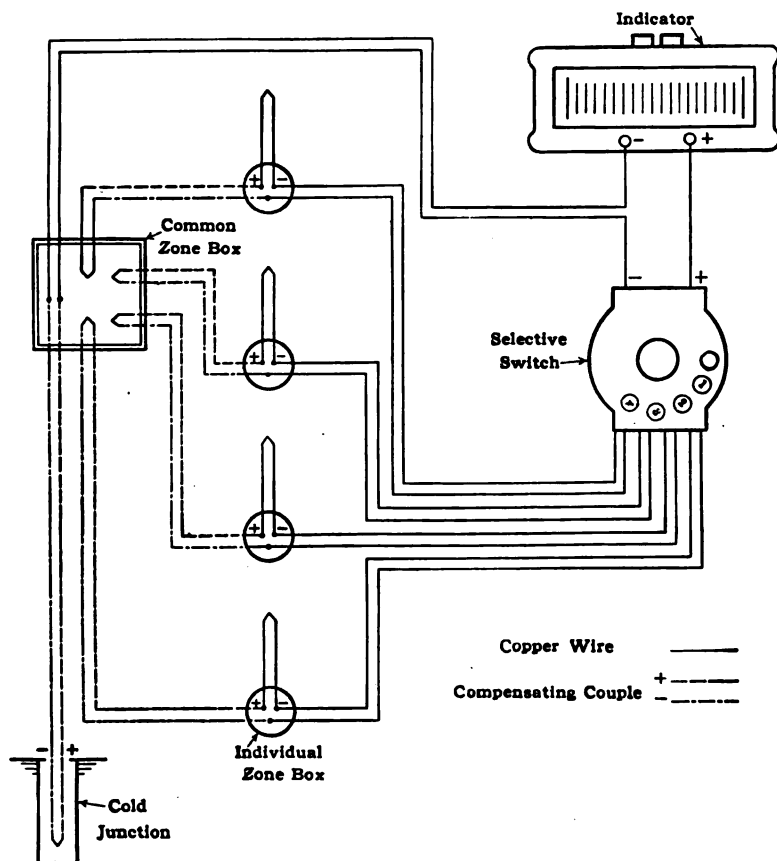


FIG. 1.

### Theory and Accuracy in Optical Pyrometry with Particular Reference to the Disappearing-filament Type

Discussion of the paper of W. E. FORSYTHE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2547.

C. O. FAIRCHILD, Washington, D. C. (written discussion\*).—Referring to the paragraph entitled "Effect of change in temperature of absorbing glass on its transmission," Dr. Foote and the writer have been using, since

\* Received Sept. 20, 1919.

June, 1916, a correction for room temperature with absorbing glasses. For Jena black glass No. 3815, with a red-glass eyepiece the effective transmission increases instead of decreases with a rise in room temperature, corresponding to a decrease in the quantity  $A$  where

$$A = \frac{\lambda_e \log Tr}{c_2 \log e}$$

The change in  $A$  was found to be approximately 0.02 per cent. per degree. Also noviweid of shade No. 7, having a very low transmission, was found to give a decreasing  $A$  when used with a red glass although the total transmission decreases and the spectral transmission curve shifts toward the red. The last is readily detected by noting the change in the tint of the glass when heated. This is also indicated by a marked improvement in the color match (upon heating) when the glass is used with a thin red-glass eyepiece. If a green glass, such as Jena 4930, is used in the eyepiece, an exceedingly great decrease in transmission is observed, consistent with the shift of the spectral transmission curve. Dr. Forsythe has not stated whether the values given in Table 4 are for a red-glass eyepiece. It is readily apparent that the room-temperature factor is quite dependent on the particular eyepiece used, in cases where the spectral transmission of the absorbing glass varies rapidly in the region of transmission by the eyepiece. So there is considerable interest in measuring the change in spectral transmission of absorbing glasses, such as has already been done with red and other colored glasses.

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### Some Factors that Affect the Washability of a Coal

Discussion of the paper of THOMAS FRASER and H. F. YANCEY, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1817.

ERNST PROCHASKA, Bonne Terre, Mo. (written discussion\*).—The special importance of this paper is the fact that it calls special attention to the existence of organic sulfur in coal. Many writers have denied the existence of a chemical compound of carbon with sulfur in coal, but later investigations, and especially the paper by Fraser and Yancey, prove undeniably its existence. As we become more fully convinced of its existence and as the present methods of washing, either in a jig or on tables, are unable to separate the organic sulfur, it remains for an inventive genius to perfect a chemical washing process whereby the sulfur will be dissolved out of the coal, or we must abandon entirely the washing of such coal.

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\* Received Sept. 20, 1919.

Another point that deserves special attention is the description of a systematically carried on investigation into the physical and chemical characteristics of the raw coal previous to the installation of a washery. This method of preliminary investigation was introduced by R. H. DeHoll and later exhaustively carried on by David Hancock, who originated the "efficiency chart," which in my opinion gives a clearer graphical picture of the physical composition of coal than the graphs by Messrs. Beers.

A good many costly washeries have proved total failures, not on account of faulty machinery or methods used but solely on account of lack of preliminary investigation. Such an investigation would have proved the coal to be non-washable and would have saved not only much money but also much disappointment, bad feeling, and reputations. A very simple, inexpensive investigation, preceded by a careful and thorough sampling of the mine, is the basis not only for the proper laying out of the flow sheet but also for the final decision as to whether or not a washery should be built. Therefore the installation of a physical laboratory should be the first step when considering the building of a coal washery. Coal washing is entering into that period of development where the familiar jig man, with a stick to determine the thickness of the slate bed, must make place for the technically trained washery superintendent assisted by a competent research chemist. Coal washing demands just as much the service of a scientist as do all other metallurgical refining processes.

### **Tin Fusible Boiler-plug Manufacture and Testing**

Discussion of the paper of L. J. GUREVICH and J. S. HROMATKO, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1351.

WM. A. COWAN, Brooklyn, N. Y. (written discussion\*).—This is evidently an excellent continuation of the work described in the article "An Investigation of Fusible Tin Boiler Plugs" by Messrs. Burgess and Merica.<sup>1</sup> The present paper gives information of much value in connection with the manufacture and inspection of fusible boiler plugs, and the investigation of the cooling curves of tin with various other metals close to the tin side of the diagram is very interesting. These curves corroborate in all cases, except that of antimony, the diagrams given by other investigators. However, only the liquidus curves of the thermal equilibrium diagrams are given, except for copper-tin alloys where one branch only of the solidus (representing the freezing of the eutectic)

\* Received Sept. 23, 1919.

<sup>1</sup> Bureau of Standards *Tech. Paper* 53; also in *Trans. Amer. Inst. Metals* (1915) 9, 21.

is given, the corresponding branch of the liquidus curve being represented by a dotted line. These are referred to in all cases as the freezing-point curves, or, as in Table 5, as the melting points. It might be clearer if they were referred to as the liquidus curves, representing only the initial freezing points of the alloys; and it would add to the value of the investigation if the cooling of the large number of alloys examined had been carried down to a lower transformation point. This would give the solidus curve and would show just how close to pure tin the eutectics are found, or would show the saturation points in case solid solutions are formed.

The determination of these additional points, particularly in cases where an eutectic is formed, should give more certain information as to the purity of the tin and as to its actual melting point or temperature of probable failure in fusible boiler plugs. For instance, in the case of tin from plug number 2788 in Table 5, which contains 0.50 per cent. copper, this alloy, disregarding the presence of iron, would be composed of 50 per cent. eutectic mixture containing 1 per cent. of copper and 50 per cent. excess tin. In cooling, the excess tin would begin to freeze out at about 228.5° C. and continue freezing through the range of temperature from 228.5° to 227.1°. The balance of the metal consisting of eutectic mixture would then freeze out at the latter temperature. The actual melting point under the conditions of use, or the temperature at which a fusible boiler plug filled with this alloy would blow out, would be at some temperature between these points, probably very close to 227.1° C., rather than at 228.5°, which is given as the melting point in the table.

In the case of the addition of antimony to tin it is interesting to note that a slight depression in the freezing point is shown by the authors to be caused by 0.10 per cent. of antimony. As described, this has not been noted heretofore in the equilibrium diagram of this series of alloys. The statement is evidently founded on the determination of only three alloys and it would be interesting if the authors would report additional tests corroborating this, eliminating the possibility that the slight depression in the freezing point may have been caused by the presence of a slight amount of a third element. The depression would undoubtedly be caused by the presence of an eutectic (if such exists) of the composition represented by the lowest temperature point, namely, 0.10 per cent. antimony and 99.90 per cent. tin, or else by a ternary eutectic formed with another element present as an impurity. If present, the eutectic should have shown in the cooling curves of the alloys located on each side of the alloy of the lowest melting point.

ALLEN P. FORD,\* Bridgeport, Conn. (written discussion†).—The specification of 99.7 per cent. pure for the pig tin is very lenient. As a matter of fact, Banca tin will run very much better than this; and it is

\* Metallurgist, Crane Co.

† Received Sept. 20, 1919.

well that it does so, because if pig tin no better than 99.7 per cent. was used, it would be very difficult to keep within the limits in the final result. We have no trouble in getting pig tin running 99.9 per cent. or better; and if this tin is properly handled, there is no difficulty in the final result.

The conclusion in regard to the analysis of the casing is, in the main, correct. This company uses a red brass, or bronze, similar to the analysis given under II, except that our lead runs a little higher. I do not think, however, that this affects the results, because where we have had any trouble, it has always been with the copper; and this agrees with the statement in the paper at the top of p. 1354 to the effect that "while copper and zinc are introduced from a brass casing, only copper is introduced from a bronze casing."

In the matter of temperature, we do not quite agree with the results given in the paper. At the temperature given, we have found it very difficult to make the tin filling stick in the casing. We have found that the tin can be poured considerably above the given temperature, that is, 275° to 300° C., and at the same time have it set in much less than  $\frac{1}{2}$  min. We find that the time of setting is a very good rough guide as to what the result will be. If the tin is what it should be in the first place and is poured at a temperature that will allow it to set in about 20 sec. or less, rarely or never will trouble be experienced; but if the time of setting goes much over this time, there is likely to be trouble; and if it goes to 1 or 2 min., the molten metal is almost certain to pick up enough metals from the casings to cause the plugs to be rejected.

One thing further to show how little a thing will affect the result. On one occasion we got a copper result in one of the tin fillings that, although not above the limit, was higher than it should have been. Investigation showed that this had been melted out by a man who did not understand the work; further investigation showed that the result could be affected by the manner in which this filling was melted out. To demonstrate it, two plugs were poured as follows: The two casings were placed upon the heating surface side by side, so that there could be no material difference in their temperature. A small ladle of tin holding just enough for three or four plugs was dipped out of the crucible of melted tin and these two casings filled, pouring one immediately after the other from the same small portion of melted tin. The two plugs were then sent to the laboratory. One of them was placed on a tripod over a small porcelain receptacle, with the large end of the tin filling down, and then gently heated with a Bunsen burner all around it until the tin filling dropped out. The other plug was placed on a similar tripod, but with the small end of the filling down, and then heated strongly on one side with a hot flame until this filling melted out. These two fillings were then separately melted and the buttons analyzed; 0.075 per cent. copper was found in the first and 0.122 per cent. in the second.

This simply shows how sensitive fusible plugs are to influences of this kind, and how expert and careful one must be in handling them to avoid error. We have even a little evidence that the copper in the tin filling may be perceptibly increased by threading the casing (which is done after the plug is filled) with a dull tool, which would necessarily heat the casing somewhat. Determinations have been made that show a slight increase apparently due to this cause; but in this case there were other possible causes present and it was not positively proved.

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### Wedging Diamond-drill Holes

Discussion of the paper of O. HALL and V. P. Row, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1597.

HUGH M. ROBERTS,\* Minneapolis, Minn. (written discussion†).—The paper by Messrs. Hall and Row marks a distinct advance in the art of diamond drilling, because it records a systematic application of a method for directing the path of the diamond bit. Their work is an admirable example of engineering development. They had a definite object to attain; *i.e.*, the drilling of many vertical diamond-drill holes to depths of 2500 or 3000 ft. (762 or 914 m.). They availed themselves of a method of wedging seldom used, improved the manner of making the wedges, developed a technique of survey, and put the process into practical, continuous operation. So effectively has this been done that they determine the average cost of the work. The publication of the results, in the form of detailed diagrams, makes the application general to whoever has a similar problem.

The wedging of diamond-drill holes has been practised in the Lake Superior region for the purpose of making branch holes, particularly where the original hole has penetrated a great thickness of glacial drift. The uneven nature of the iron formations has caused the results to be somewhat uncertain. One operation, in 1907, near the American mine on the Marquette Range, by the firm of Longyear & Hodge, predecessors of the E. J. Longyear Co., resulted in the drilling of a hole 1828 ft. (557 m.) deep, with two branches at depths 100 ft. (30 m.) and 770 ft. (234 m.), respectively. A second hole from the same set-up went to a depth of 2497 ft. (761 m.) with a branch at 1850 ft. (563 m.). In this instance, the wedges were forged to the desired shapes and angles with respect to each other. A drill hole, sunk in 1915, in the township of Bates in the Iron River district of Northern Michigan, which penetrated 385 ft.

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\* E. J. Longyear Co.

† Received Sept. 22, 1919.

(117 m.) of boulders and gravel, was also similarly deflected for the purpose of taking a second sample across the iron formation. The wedging of diamond-drill holes has been accomplished in the copper country, there also for the making of branch holes. However, it has remained for Messrs. Hall and Row to develop a precise method that can be generally applied.

In their paper, the authors touch upon methods of surveying diamond-drill holes. These are generally unsatisfactory because of the limited size of the hole, expensive by reason of the time consumed, and the results of the surveys usually leave a feeling of uncertainty in their wake. It has occurred to me that if a method of survey could be devised that would be entirely independent of the drill hole itself, it would be desirable.

The grinding of a diamond bit may be heard distinctly for long distances through solid rock, even through a hundred feet of glacial drift. Listening instruments of great accuracy have been developed in connection with underground warfare in Europe. One instrument known as the American geophone, a simplified seismograph, has been developed by the United States Army Engineers, and has lately been applied by the U. S. Bureau of Mines to purposes of mine rescue. Officers who have served in Canadian tunneling regiments state that the position of German headings could be determined by means of listening instruments, from the sounds of tools at work, with accuracy through chalk at distances of 1000 ft. (304 m.) or more, not only as to position in azimuth but as to elevation. In a solid rock, like the norite of the Sudbury district, sound waves are transmitted distinctly. By applying the geophone to the survey of diamond-drill holes, it may be possible to fix the position of the bit while at work at various points in the hole, say every 100 ft. (30 m.) in depth, and thus determine quickly and with a fair degree of precision the path of the drill hole in three dimensions. The method would be particularly applicable to the survey of angle holes. These instruments are as yet in the hands of the Corps of Engineers and the Bureau of Mines. The Bureau of Mines has indicated a willingness to make tests on the application of the geophone to the survey of diamond drill holes. The results will be watched with great interest.

The paper by Messrs. Hall and Row brings forcibly to mind the growing effectiveness of the diamond drill as an exploring agent. The prime necessity in any mining enterprise is an orebody to work. Improvements in the methods used for discovering orebodies and determining their nature are of great importance to the whole mining industry.

## Physical Properties of Nickel

Discussion of the paper of DAVID H. BROWNE and JOHN F. THOMPSON, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2693.

WILLIAM B. PRICE\* and PHILIP DAVIDSON,† Waterbury, Conn. (written discussion‡).—A few months ago we became interested in determining the properties of pure nickel as a metal for certain uses and arranged, in coöperation with the International Nickel Co., a series of tests on cold-rolled so-called pure nickel and both longitudinal and transverse specimens annealed at 100° intervals from 250° to 1050° C. Since our tests confirmed, in a general way, the observation put forth by Messrs. Browne and Thompson, they are given at this time.

A bar of hot-rolled nickel about 9 in. (23 cm.) wide and  $\frac{1}{2}$  in. (12.7 mm.) thick made by the International Nickel Co. of grade A stock, analyzing nickel plus cobalt 98.48 per cent., iron 0.67 per cent., manganese 0.27 per cent., carbon 0.07 per cent., silicon 0.162 per cent., sulfur 0.033 per cent., and copper 0.22 per cent., was cold-rolled down to a final thickness of 0.134 in., making a 73.2 per cent. reduction by rolling. Test specimens, 9 by 1 in., cut parallel (marked longitudinal) and normal (marked transverse) to the direction of rolling were milled to give a test section  $2\frac{3}{8}$  in. long by 0.5 in. wide. Three specimens each, longitudinal and transverse, were annealed at one time in a nichrome-ribbon-wound tube furnace. The temperatures were taken with a Pt-PtRh thermocouple in conjunction with an Engelhard millivoltmeter. An annealing period of  $\frac{1}{2}$  hr. plus 25 min. preheating was used in all cases. Scleroscopic and Brinell hardness tests and static tensile tests were made on the rolled and annealed specimens. The tensile tests are shown in graphic form in Fig. 7. The Brinell and scleroscopic values are given herewith.

| Treatment of Specimens                     | Brinell Number |          | Scleroscope      |                  |
|--|----------------|----------|------------------|------------------|
|  | 500 Kg.        | 3000 Kg. | Universal Hammer | Magnified Hammer |
| Cold rolled $\frac{1}{2}$ in. to 0.134 in. |                | 235      | 37.0             | 71.0             |
| 250° C.                                    |                | 262      | 37.0             | 68.5             |
| 350° C.                                    |                | 255      | 36.7             | 70.5             |
| 450° C.                                    |                | 248      | 35.0             | 67.0             |
| 550° C.                                    |                | 228      | 32.0             | 60.0             |
| 650° C.                                    | 136            | 166      | 20.0             | 43.0             |
| 750° C.                                    | 74             | 112      | 9.5              | 20.5             |
| 850° C.                                    | 67             | 105      | 8.0              | 16.5             |
| 950° C.                                    | 63             | 101      | 7.0              | 15.0             |
| 1050° C.                                   | 61             | 101      | 6.5              | 14.5             |

\* Chief Chemist and Metallurgist, Scoville Mfg. Co.

† Metallurgist, Scoville Mfg. Co.

‡ Received Sept. 27, 1919.

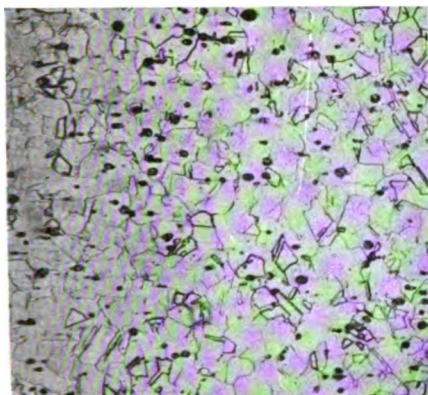


FIG. 1.—HOT-ROLLED BAR ON 0.5 IN. AS RECEIVED.

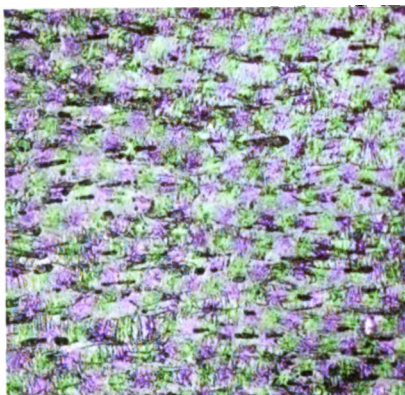


FIG. 2.—COLD-ROLLED FROM 0.500 IN. TO 0.134 IN.

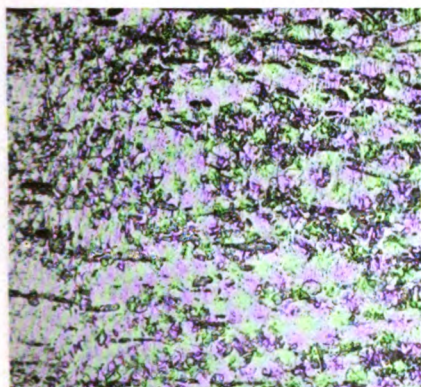


FIG. 3.—SAME AS FIG. 2, ANNEALED AT 650° C.

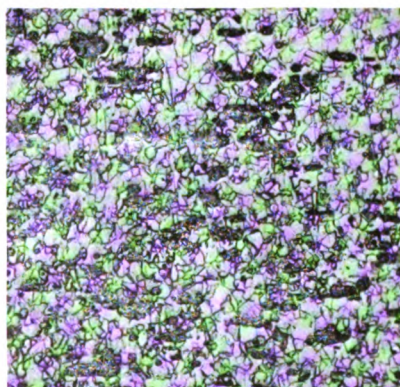


FIG. 4.—SAME AS FIG. 2, ANNEALED AT 750° C.

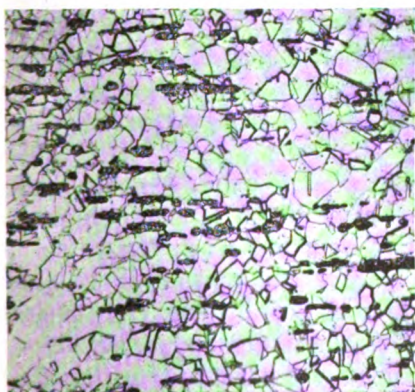


FIG. 5.—SAME AS FIG. 2, ANNEALED AT 850° C. ETCH:  $\text{HNO}_3$  IN ALCOHOL.  $\times 75$ .

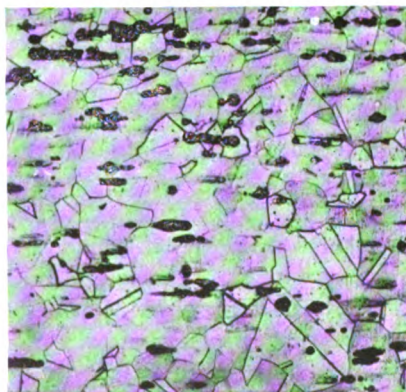


FIG. 6.—SAME AS FIG. 2, ANNEALED AT 1050° C.

**Microstructure.**—The micrographs, Figs. 1 to 6, show that, structurally, nickel behaves in practically the same way as a copper-zinc or copper-tin alpha solid solution, crystal twinning being much in evidence in material annealed after cold working. As shown in Fig. 1, the hot-rolled material has been finished at a high enough temperature to leave the crystals in an equiaxed condition. Rolling deforms the grain and produces etch bands, as shown in Fig. 2.

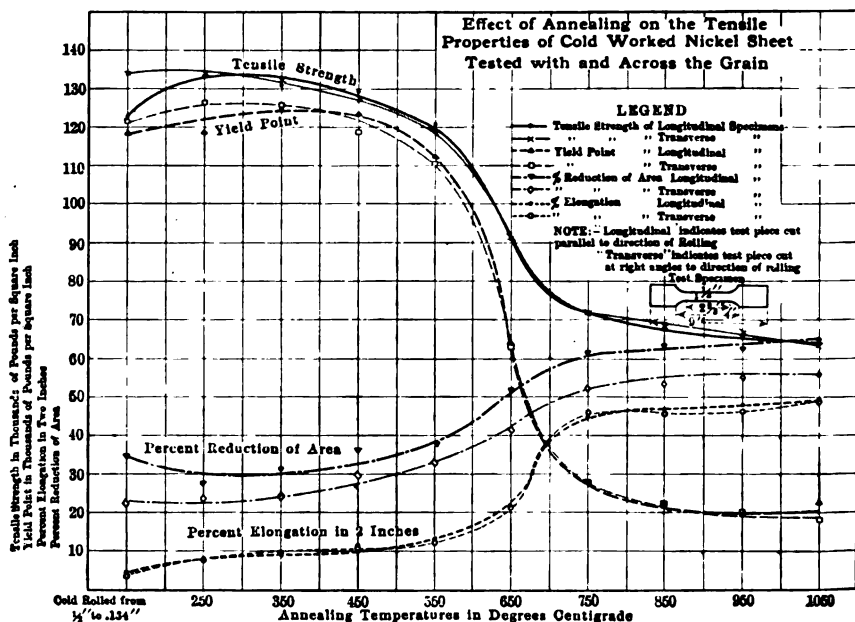


FIG. 7.

The temperature of recrystallization of hard-rolled nickel sheet is some 300° C. higher than that of hard-rolled alpha brass. No visible recrystallization, as seen under moderate magnification, is noted until a temperature of 650° C. is attained. At 750° C. complete recrystallization takes place, as shown in Fig. 4; beyond this the grain size increases somewhat with the rise in annealing temperature.

**Tensile Tests.**—The results of tensile tests are shown graphically in Fig. 7. The first decided softening takes place at 650° C. and equilibrium conditions are nearly attained at 750° C. Beyond 750° C., the softening is very gradual. The longitudinal and transverse annealed specimens appear to behave very much the same in the case of all values except those representing reduction of area. Here the longitudinal values are higher than the transverse values by approximately 8 per cent. In the case of the hard-rolled specimens, the transverse specimens have a tensile strength some 10,000 lb. greater than the longitudinal.

## Influence of Heat Treatment on Gun Metal

Discussion of the paper of C. F. SMART, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1875.

GEO. F. COMSTOCK,\* Niagara Falls, N. Y. (written discussion†).—This interesting paper throws additional light on a question about which differences of opinion have apparently existed in the past, and the writer would like to record in this connection the agreement of his experience with that of Primrose and Prof. Smart in regard to the effect of quenching on the properties of gun-metal bronze. The writer's results have been published,<sup>1</sup> so that there is no need for a detailed report here, but his investigations resulted in showing that both gun metal and manganese bronze are ruined by quenching in water from a red heat, apparently because they cannot stand the strains produced by the sudden cooling.

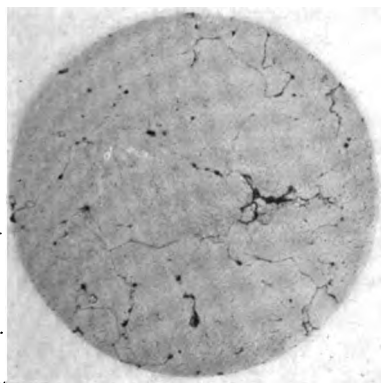


FIG. 1.

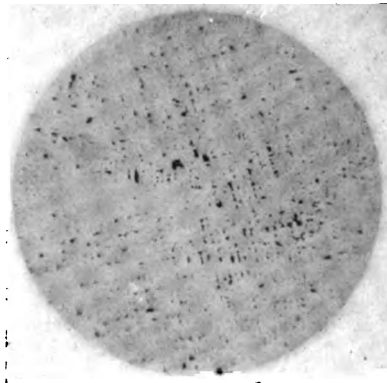


FIG. 2.

The lines, mentioned by Prof. Smart, in a polished and etched section of the quenched metal have also been noticed by the writer, who however has not found them any different in quenched specimens than in annealed specimens. Since they appear only after etching, it would seem most probable that they are merely grain boundaries in most cases, though Prof. Smart's idea that they are indications of strains is by no means impossible. Fig. 1 shows how these lines appeared on the author's specimens of annealed gun metal, etched with ammonia and hydrogen peroxide, and magnified 100 diameters.

Prof. Smart's specific-gravity determinations are interesting in connection with the writer's experience that the annealed bars are always

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<sup>1</sup> *Foundry* (Apr. 15, 1919) 47, 189.

much more porous than the same alloy was when cast. Fig. 2 shows an especially porous specimen of this alloy, etched like Fig. 1 and magnified 20 diameters, which however seemed sound when tested and gave over 45,000 lb. per sq. in. tensile strength and 40 per cent. elongation. The writer's idea of this porosity was that in the cast metal there were inclusions of gas in the form of films between the dendritic crystals, and that these films were so thin that they escaped detection under the microscope. Upon annealing, the films were thought to contract by surface tension, and the gas then formed rounded cavities which were much more noticeable on the polished surface. From the lower specific gravity which Prof. Smart has shown, it seems as though the included gas had actually expanded the metal somewhat in forming these more rounded cavities.

The range of composition that Prof. Smart allowed in his test bars, namely from 9 to 11 per cent. tin, was far too large for obtaining check results, as very different results would be obtained with these two tin contents even with identically the same treatment. Doubtless some of the irregularities in his curves are due to variations in analysis. The paper is of great interest and helps to clear up an uncertainty that existed in connection with the results of quenching this well-known alloy.

### Engineering Features of Modern Large Coal Mines in Illinois and Indiana

Discussion of the paper of C. A. HERBERT and C. M. YOUNG, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2445.

EUGENE MCAULIFFE, St. Louis, Mo. (written discussion\*).—When we undertook the development of the Kathleen mine, near DuQuoin, certain features greatly influenced the construction and underground development. The country is very flat, so that the usual gravity yard movement of empty and loaded coal cars would entail a very heavy fill at the empty-car end of the tracks, with some form of car-pulling arrangement to move the loads where it was practically impossible to provide a gravity movement. So the yard was made level, except for 1000 ft. (304 m.) under the two tipples, where the cars are moved by gravity and controlled under the main-shaft tippie by four Fairmont car retarders. Both tipples are spread sufficiently to admit of introducing a narrow-gage track and locomotive. One 18-ton locomotive is at present employed in moving empties down to a point above the main-shaft tippie and the loads off the track scales down into the storage yard; ultimately a 25-ton locomotive will be employed on the loaded side of the tippie. This form of car movement and control will admit of handling empty and loaded cars

\* Received Sept. 27, 1919.

promptly in winter weather without the employment of a large number of men, as is commonly practised.

The main-shaft tippie was designed to include ample screen area with picking tables and loading booms on the nut, egg, and lump tracks, insuring the best possible dry cleaning of the screened product. The control of all machinery in the tippie is in the hands of one operator, centrally located. A number of push-button controls conveniently located at different points in the tippie enable any employee to throw off the power instantaneously.

In designing the underground layout, including pit cars with roller-bearing wheels and a capacity of approximately 5 tons, together with a two-car rotary dump, due attention was given to the matter of reducing to a minimum the number of employees required to handle the mine bottom. One operator, centrally located at the shaft bottom, handles the movement of the loaded trip over two pairs of pit car scales, placed tandem, through the rotary dump, thence to the empty-car tracks. All the cars remain coupled throughout; that is, each trip is coupled to the one preceding it, making a continuous train passing through the rotary dump, sufficient empty cars being cut off below the rotary dump to meet the requirements of the outbound empty trip. This reduces the labor of coupling and uncoupling at the shaft bottom to a minimum. The rotary dump and its attendant mechanism, including the trip control, are handled by one operator through the medium of compressed air. It was our idea to reduce as far as practicable the number of men employed at other than coal loading, using the largest possible transportation unit, reducing transportation costs. It was thought that a high hourly hoisting capacity would be desirable in view of a possible reduction of hours per working day.

The matter of providing houses for mine employees was given very serious consideration. The decision finally reached was that the coal company would confine its effort to insuring the sale of building lots and the construction of houses for its employees under terms that were fair and reasonable, with ample provision for time payments either made to a townsite company separately organized, in which the mining company has no financial interest, or through a building and loan association.

The Illinois mining law requires the construction and maintenance of wash houses for employees. In designing these, an attempt was made to insure absolute cleanliness. Two steel lockers were provided for each employee, one for pit clothes and one for street clothes; also provision for drying damp clothes, so as to insure as far as possible the absence of disagreeable odors so commonly experienced in miner's wash houses. No provision for washing other than through the medium of a shower bath was provided, with the result that 95 per cent. of the employees fully bathe and change their clothes before leaving the wash house.

No seats whatever are provided in the locker room, which discourages loafing there.

A. G. REESE,\* Cleveland, Ohio (written discussion†).—As the hoists and skips mentioned were installed by the Wellman-Seaver-Morgan Co., some of the principal features of these hoists and skips may be of interest.

All the rotating parts of both hoists are of steel, the drums having machine-turned grooves. All the bearings are of the ring oiling type, the pinion-shaft bearings of the skip hoist being provided with removable shells. Each hoist is provided with a parallel acting post brake; the brake beams are of structural steel and the supporting links, operating levers, and connections are of cast steel and forgings. Both hoists are driven through one reduction of herring-bone gears enclosed in an oil-tight housing of structural steel, supported on the hoist bed plate. The brakes are applied by gravity and released by cylinders operated by compressed air at 90 lb. (39.7 kg.) pressure, the air being supplied by two electrically driven air compressors, each having a piston displacement of 72 cu. ft. (2 cu. m.) of free air per minute. The hoist houses are located about 300 ft. (91 m.) apart with one compressor and receiver in each hoist house, the receivers being connected by piping, which arrangement allows the brakes of both hoists to be operated from either one of the compressors, the other compressor being used as a spare unit.

The cage hoist is at present hoisting 1000 tons of coal per 8 hr., using only one cage, the load being partly balanced by a counterweight of 18,000 lb. The total load on the cage rope is 24,380 lb., which is divided as follows: cage 11,000 lb., coal car 4500 lb., coal 8000 lb., rope 880 lb. The rope speed is 1000 ft. per min.

The skip hoist is used for hoisting the coal in self-dumping skips operating in balance. The capacity of the hoist is 6400 tons of coal in 8 hr. on the basis of 8 tons per trip, or 8000 tons on basis of 10 tons per trip, the load being as follows:

|            | AVERAGE CONDITION,<br>POUNDS | MAXIMUM CONDITION,<br>POUNDS |
|------------|------------------------------|------------------------------|
| Skip.....  | 20,000                       | 20,000                       |
| Coal.....  | 16,000                       | 20,000                       |
| Rope.....  | 1,580                        | 1,580                        |
| Total..... | 37,580                       | 41,580                       |

The average rope speed is 980 ft. per min. The flywheel of the motor-generator set has sufficient capacity for completing the hoisting cycle from any point in the shaft, after acceleration is completed, in case of failure of main-line current.

\* Engineer, Wellman-Seaver-Morgan Co.

† Received Sept. 24, 1919.

The calculated running light losses of the motor-generator set is 32 kw. The calculated power consumption under normal hoisting conditions is 0.485 kw.-hr. per ton.

The power for both hoists is purchased from the Central Illinois Public Service Co. at 33,000 volts, three-phase, 60-cycle, and is transmitted by wooden pole construction from a steam plant located at Christopher, Ill., a distance of about 20 miles.

The skips at the Standard mine have a capacity of 414 cu. ft. or 12 tons of coal and are designed to operate in a shaft compartment having T-rail guides. The body of skip, 6 ft. by 6 ft. 3 in. by 12 ft., is made up of  $\frac{3}{8}$ -in. plates,  $2\frac{1}{2}$  by  $2\frac{1}{2}$  by  $\frac{7}{16}$  in. angles and four 1 by 6 in. stiffener bars extending around four sides of the skip. The sides of the guide frame are made of 3 by  $2\frac{1}{2}$  by  $\frac{3}{8}$  in. angles riveted to a  $\frac{7}{8}$  by 16 in. plate running the entire length of guide frame. The skip is provided with spring drawbar and steel safety catches. Total weight of each skip is 19,000 pounds.

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### Research in the Coal-mining Industry

Discussion of the paper of E. A. HOLBROOK, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1723.

J. J. RUTLEDGE,\* McAlester, Okla. (written discussion).—Research work has often a more immediate and practical application to the industries than even the investigators themselves realize, but coal mining has not attracted the investigator, except in so far as the mine-accident prevention work and fuel investigations are concerned. In future, the coal geologist will study the subsurface geology of the various coal seams as the petroleum geologist now studies the oil sands, and from the results of these studies the coal operator will be able to locate his shafts to the best possible advantage and to avoid faults that would interfere with underground work. There would have been many thousands of dollars saved, and perhaps some reputations, if a good stratigrapher had been called into consultation in the southern part of Somerset County, Pa., where a local seam of coal, quite thick, was mistaken for the Pittsburgh seam, which, if ever present at that point, had long since been eroded.

Why will the Quemahoning coal carry more sulfur without injuring the grate bars than George's Creek Big Vein? Only the investigator can answer and yet the fact that the above is true means a greater price for the thinner coal.

The owner of the land in Oklahoma receives one-fourth of the cotton crop produced by the tenant who farms his land and one-third of the

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\*Geologist, U. S. Bureau of Mines.

†Received Oct. 6, 1919.

corn crop. In the spring, when cotton is just beginning to grow, frequently the owner will see that the land is kept free from grass if the tenant does not in order that he may not lose his rent; yet owners of coal lands in the same state permit the lessees of their land to wastefully mine only from 40 to 50 per cent. of the coal in the seam and to pay a royalty only on the amount mined while the remainder of the coal is left unmined in the ground and is irretrievably lost. Even the farmer is more business-like than the coal-land owner and mine operator. Moreover, by the adoption of an improved system of mining the coal recovery can be increased from 40 to 50 per cent. to 70 and 80 per cent. and the cost of production reduced 15 to 50 c. per ton.

The coal-mining industry is as much entitled to have demonstration mines, supported at Government expense, as the farming industry is to have the demonstration farms and plats. In this work the Government should be the pioneer, as private capital cannot lead the way on account of financial and labor difficulties. At least two machine long-wall mines in the Southwest are recovering all the coal with a production of 90 per cent. lump. If roof-slaking could be prevented during the hot summer months, the saving would be from 15 c. to \$1 per ton of coal produced. Will it not pay to investigate and learn what will stop the slaking?

Even those who were, and are still to some extent, prejudiced against the use of permissible explosives and machine mining testify to the reduction in accidents and destruction of property since black powder has been abolished. Research gave the permissible explosive and it was a profitable investment. The closed light, had it been in use, would have saved many lives and much loss of output and wages and destruction of property. The oil and gas operators gladly use the closed lights developed by research work.

The economics of coal mining should be investigated: Why was the zone system the best regulation that the coal-mining industry ever had? Why should a portion of the best longwall coal field in America, in northern Illinois, almost within sight of the great Chicago market, be practically abandoned and the southern Illinois coal mines, 200 mi. farther south, ship their coal directly past the old longwall district into the Chicago market? How is it that southern Illinois operators can ship coal to Texas and drive therefrom the Oklahoma operators whose mines are only a few hundred miles distant? Research will tell.

Psychology will tell why some operators have no trouble with their miners and others are always bothered by strikes.

But the greatest field for research is in methods of working coal. Thousands of dollars are spent in sinking shafts and equipping mines with the latest and most efficient machinery, but when the coal seam is reached, some foreman or subordinate employee decrees what methods

of working shall be employed, prejudice and inexperience holding full sway. When demonstration mines are provided and research work is carried on, the "angle of break" will be as important to the mining engineer as the "angle of repose" is to the civil engineer and the laws governing subsidence will be known to some extent, and coal mining will take rank as a profession.

### Blast-furnace Refractories

Discussion of the paper of R. M. Howz, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1791.

J. S. Unger,\* Pittsburgh, Pa. (written discussion†).—I heartily agree with the author's suggestion, near the close of the paper, that greater uniformity in the making and use of brick is desirable. The effect of the manner of laying the brick, the mortar or cement used, the necessity of standardizing the shapes, the elimination of irregular or poorly designed brick, and the necessity for uniform operating conditions were pointed out by me some years ago.

Many factors influence the quality of firebricks. The following figures obtained from bricks during their making or after completion show the need for greater uniformity in their quality. These results were obtained from regular commercial bricks, shipped to the consumer. In many cases the samples were from the same car load.

#### VARIATIONS IN MOISTURE CONTENT OF PUG AS BRICKS WERE BEING MADE

|   | PER CENT.<br>MOISTURE |
|---|-----------------------|
| Column of pug from extrusion machine.....   | 9.0                   |
| Column of pug from extrusion machine taken 10 min. later...                             | 11.0                  |
| Moisture in pug from pan having finished grinding pug for<br>blast-furnace bricks ..... | 8.7                   |
| Same pan, new charge 20 min. later.....   | 12.0                  |

#### FINENESS IN TWO PANS GRINDING SAME MATERIAL FOR SAME GRADE OF BRICK

| Pan    | Per Cent.<br>on $\frac{1}{4}$ in. Mesh | Per Cent.<br>on $\frac{1}{2}$ in. Mesh | Per Cent.<br>on 20 Mesh | Per Cent.<br>on 40 Mesh | Per Cent.<br>through 40 Mesh |
|--------|--|--|-------------------------|-------------------------|------------------------------|
| A..... | 1.7                                    | 4.2                                    | 26.0                    | 20.0                    | 48.1                         |
| B..... | 0                                      | 1.0                                    | 21.0                    | 18.0                    | 60.0                         |

\* Central Research Bureau.

† Received Oct. 6, 1919.

**PERCENTAGES OF SPALLING LOSS  
AT 1350°, BRICKS FROM  
DIFFERENT MAKERS**

| KIND OF BRICK        | SPALLING LOSS,<br>PER CENT. |
|----------------------|-----------------------------|
| 1, Machine made..... | 26.9                        |
| 2, Machine made..... | 11.7                        |
| 3, Machine made..... | 9.4                         |
| 4, Hand made.....    | 7.3                         |
| 5, Hand made.....    | 3.4                         |

**SPALLING LOSS ON CHECKER  
BRICKS FROM DIFFERENT  
MAKERS**

|                   | SPALLING LOSS,<br>PER CENT. |
|-------------------|-----------------------------|
| Coarse grind..... | 8.4                         |
| Fine grind.....   | 49.9                        |

**CRUSHING STRENGTH OF TEN  
BRICKS FROM SAME CAR  
CRUSHED AT 1350° C.**

|    | POUNDS PER<br>SQUARE INCH |
|----|---------------------------|
| 1  | 662                       |
| 2  | 828                       |
| 3  | 1013                      |
| 4  | 1112                      |
| 5  | 1307                      |
| 6  | 1343                      |
| 7  | 1581                      |
| 8  | 1657                      |
| 9  | 1683                      |
| 10 | 1708                      |

**SLAGGING TESTS—PENETRATION OF  
MOLTEN BLAST-FURNACE SLAG AT  
1350° C., THREE BRICKS OF  
EACH BRAND**

| BRICK | PENETRATION,<br>IN SQUARE INCH |
|-------|--------------------------------|
| A, 1  | 0.10                           |
| A, 2  | 0.50                           |
| A, 3  | 0.70                           |
| B, 1  | 0.10                           |
| B, 2  | 0.20                           |
| B, 3  | 0.50                           |
| C, 1  | 0.40                           |
| C, 2  | 1.20                           |
| C, 3  | 1.50                           |

An example of inspection by the eye of two carloads of bricks of same grade from same maker showed the following percentage of cracked, warped, badly molded, or otherwise defective bricks. Car A, 15.25 per cent.; Car B, 0.30 per cent. Many other examples could be given but it is believed the preceding figures are sufficient to show the need for a pronounced improvement in the uniformity of blast-furnace bricks.

### Manufacture of Steel Rails

Discussion of the paper of R. W. HUNT, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2339.

HENRY G. MARTIN,\* Chicago Heights, Ill. (written discussion†).—The object in taking three or more ladle tests is to secure a sample that will show the average composition of the heat, not primarily to investigate the lack of uniformity existing; however, the assumption that the samples are not of uniform composition remains. In other words, we have three samples of steel of different composition, the particles of which are not subject to extreme comminution so as to mix intimately, and yield an average homogeneous sample, if placed in one

\* Railway Steel-Spring Co.

† Received Oct. 6, 1919.

container. Therefore if so mixed and the chemist weighs a portion for analysis, he does not get equal parts of each of the original samples, but, if the original samples be kept separate until they reach the balance, he can easily weigh an equal portion from each, combining the three weighings for his analysis, if it is inexpedient to run separate determinations. I have followed this practice for probably 20 yr. and find it the best means to avoid discrepancies in laboratory results. As it is, there is always difficulty in securing a homogeneous sample from one drill hole only, if proper consideration has not been given to shape and cooling of the test piece.

### Experimental Data Obtained on Charpy Impact Machine

Discussion of the paper of F. C. LANGENBERG, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1471.

GEO. F. COMSTOCK,\* Niagara Falls, N. Y. (written discussion†).—In this exposition of experimental data, the author infers, indirectly at least, that by the Charpy test information was obtained that led to the improvement of certain ordnance parts and that this improvement could not have been attained without the Charpy test. On examination of the data, however, it appears that the important point of the whole matter was that while the material had been accepted from the results of longitudinal tensile tests, it was really transverse ductility that was desired. The writer has no desire to attempt to detract from the value of the paper or to discredit the Charpy test in any way, but he would like to ask the author if he will not give more clearly his reasons for preferring the Charpy impact test for investigational and control work of this kind, over the more usual tensile test made in a transverse direction. The tensile test pieces are more cheaply made than the square notched impact bars; and from the former the limit of elasticity and the ultimate strength as well as the ductility are obtained, while in the Charpy test only one property is measured. It does not seem that the author has shown a sufficient reason for favoring the latter test, when both it and the transverse tensile test served his purpose equally well in indicating the proper metal and treatment required for his special forging, and it is hoped that this reason will be given more clearly as a matter of useful general information.

A. G. ZIMMERMANN,‡ Washington, D. C. (written discussion§).—The Watertown Arsenal is to be congratulated on performing some excel-

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‡ Lieutenant Commander, U. S. N., U. S. Naval Gun Factory.

§ Received Oct. 6, 1919.

lent pioneer work in accumulating data relative to the shock resistance of material used for ordnance purposes. Doctor Langenberg's work serves to demonstrate the correctness of two principles which should be the basis of all inspection by the consumer of materials subject to shock where impact testing machines are not available or where the data on results with impact testing machines are not considered conclusive enough to form the basis for specifications.

These two principles are: (a) Acceptance of forgings need not necessarily be based on the performance of test bars pulled in the direction of the stresses that will be applied in service. (b) Material that has normal ductility in its weakest plane is a good shock-resisting material.

The first principle follows the fundamental idea that if the most unfavorable test of the material is definitely known, the inspector has good grounds for assuming that the remainder of the forging is as good or better, when viewed from any other angle, as the results on which he accepted the forging. This is the more reasonable since, as pointed out by Doctor Langenberg, it is not always safe to say that no transverse stresses will be set up when, theoretically, the stresses of service are longitudinal.

If the location of test specimens is to be determined beforehand, irrespective of the method of forging, there would be an undue incentive to the manufacturer to do excessive forging in the direction of the test specimen. It is undoubtedly true that the more forging material receives in one direction, beyond a certain point, the less will be its ductility at right angles to this direction—and this effect is much more marked in basic steel than in acid steel. Since sudden shock appears to search out the weakest plane of a forging, it is apparent that normal ductility in one direction should not be sacrificed for a good showing in ductility in another direction.

Doctor Langenberg's results, showing that the impact test follows somewhat the course indicated by the results of the transverse static test, is borne out by the fact that the Naval Bureau of Ordnance has been following the above principles of inspection for some time and a consultation of the records fails to disclose any failures of material in service that have been traceable to the failure of accepted material under normal shock conditions. However, impact tests should be the principal criterion of any shock-resisting material, and it is hoped that their use in both commercial and ordnance work will rapidly come into favor. It is considered imperative, however, for the general use of such a test, that conditions should be standardized in the beginning, so that no confusion or change of equipment will result upon the incorporation of a standard test in the specifications. It is considered that there should be an early decision as to standard American practice in the following

particulars, in order that the impact test may become a part of the routine procedure of buying materials subject to sudden stresses:

1. A selection of either the pendulum or the vertical drop type of impact testing machines.
2. A selection of either notched or unnotched bars.
3. If notched bars are selected, the immediate selection of a standard notch, so that the practice of playing with various types of notches, such as has been done in other countries, be nipped in the bud, and some consistent data will quickly be assembled.

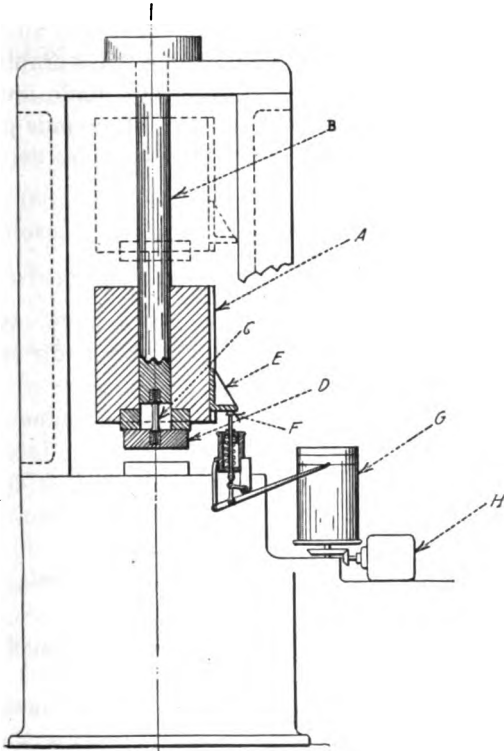


FIG. 1.—VERTICAL DROP MACHINE.

4. If possible, the adoption of an impact test whereby the resistance of the material can be reduced to an equivalent of pounds per square inch, which will have a more definite meaning to the ultimate consumer of this country and will obviate the necessity of a tabulation of new units in the customary reports of physical test.

This last point is not so far removed from possibility as it may seem at first glance. What appears to be a very workable arrangement has been devised at the U. S. Naval Gun Factory, for use with a vertical drop machine, by Lieut. G. Q. Lewis, of the Navy, who was assigned this task

in connection with the contemplated activities of the enlarged physical laboratory of the Gun Factory. The essential features of the apparatus consist of a weight *A*, Fig. 1, which is guided by a central shaft *B* and can fall from any predetermined height, striking a hardened plate *D* and rupturing in tension the standard test bar *C*, the ends of which are screwed into the lower end of the shaft *B* and the plate *D*, respectively. A bracket *E* suitably secured to the weight *A* engages a plunger *F* of a device that amplifies the vertical movement of the weight just before and during the period of rupture. A pencil record of the amplified movement is made upon a paper cylinder mounted on a drum *G*, which is rotated at a known constant speed by the motor *H*. The object of the amplification is to obtain a space-time curve of such proportions that a graphic or protractor analysis may be conveniently and accurately made and the resisting value of the material tested derived in terms of pounds per square inch.

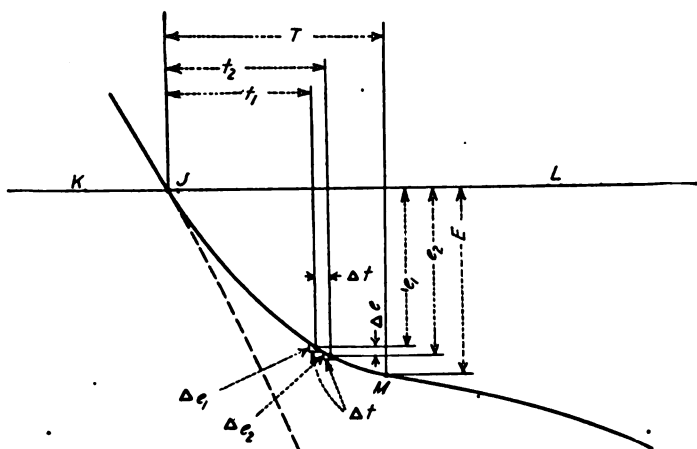


FIG. 2.—RELATION OF ELONGATION OF TEST BAR WITH REFERENCE TO TIME.

The curves obtained show the relation of the elongation of the test bar with reference to time. For a typical curve (see Fig. 2), the elongation would be measured vertically and the time horizontally to known scales, depending on the amplification and surface speed of the drum. The weight, being released from a suitable predetermined height, accelerates uniformly and attains maximum velocity at a certain point *J* where the pencil line crosses a horizontal base line *KL*, previously scribed on the drum with the weight resting on the plate *D*, Fig. 1, which is screwed to the lower end of the test bar. The tangential motion of the paper drum being to the left, the rupture curve is drawn downwardly and to the right. Above the base line is recorded the last portion of the parabolic free fall of the weight and below is recorded the movement of same as retarded by the resistance of the test bar. The curve reverses after crossing the

base line and the slope of the same decreases as the bar elongates, owing to the reducing velocity of the weight. After rupture occurs at  $M$ , the curve reverses and the weight again accelerates, due to gravity.

Analysis of the curve between the initial and the final points of test-bar resistance gives the average forces of retardation corresponding to increments of elongation,  $\Delta e$ , measured normally to the base line. To determine the average retarding force during any time increment  $\Delta t$ , the slopes or tangents of the curve are first obtained at the beginning and the end of the time increment  $\Delta t$ , to determine the corresponding instantaneous velocities of the weight at these points. Thus the tangent to the curve or its equal, the instantaneous velocity of the weight at the beginning of time increment  $\Delta t$ , is  $\frac{\Delta e_1}{\Delta t}$  and at the end is  $\frac{\Delta e_2}{\Delta t}$ . The acceleration during the period  $\Delta t$  is  $\frac{\Delta e_2 - \Delta e_1}{\Delta t^2}$ .

The average force of retardation  $F$ , in pounds, during any increment of time  $\Delta t$ , therefore, equals the product of the mass and the acceleration, or  $K \frac{\Delta e_2 - \Delta e_1}{\Delta t^2}$ , where  $K$  is a constant depending on the mass of the weight and the units employed in measuring  $\Delta e$  and  $\Delta t$ .  $F$  will be algebraically negative because the acceleration is negative. Thus the stress, exerted by the test bar to resist the retardation force of the weight  $W$ , will be  $+F$ , since it is equal but opposite in direction to that imposed by the weight. The total stress in the bar will then be algebraically equal to  $W + F$ , where  $W$  is the number of pounds in the weight, also resisted by the test bar because of gravitation.

It is not to be assumed that calculations of this description will be necessary for each specimen pulled, as a protractor has been designed which will integrate the space-time curve throughout the entire elongation period of the specimen and thus permit a ready selection of critical values, read directly in pounds per square inch.

While Lieutenant Lewis, who has now returned to his former activities in the supplying and testing of railroad materials, had the benefit of previous research in connection with railroad shock absorbers, it is considered that this method of analysis is considerably different from any performed before, in that it goes further and gets an expression of the strength of material, in pounds per square inch, which is a function of the amount of energy expended in rupturing the specimen.

The Naval Gun Factory will appreciate receiving criticisms of the proposed method, and, when the new physical laboratory is operating, will be glad to share with the members of this Institute any information obtained on this question.

### Chemical and Electrochemical Problems Involved in New Cornelia Copper Co's. Leaching Process

Discussion of the paper of H. S. MACKAY, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1929.

W. L. AUSTIN, Riverside, Calif. (written discussion\*).—The profession is much indebted to the management of the New Cornelia Copper Co. for releasing the valuable data contained in the paper by Messrs. Tobelmann and Potter. While there must have been good reasons for the procedures adopted, in view of the results obtained the question arises as to whether the methods employed are the very best that might be used.

According to the figures given for 1918, there were passed through the electrolytic vats, in round numbers, an average of 8950 tons of solution in 24 hr., from which about 13 per cent. of the contained copper was extracted: afterwards the solution, still carrying 87 per cent. of the original copper content, was returned to the ore-leaching department to recommence the cycle. In other words, the electrolytic method is shown to extract a relatively small percentage of the copper contained in the electrolyte while necessitating the circulation of a large tonnage of solution for the sole purpose of picking up a little more copper before returning to the electrolytic vats. Because of carrying this load of copper around and around through the whole treatment system, which serves no useful purpose, the idea forcefully suggests itself, Would it not be better practice to remove the copper wholly from the lixiviant by some chemical precipitant—hydrogen sulfide for instance—which releases the solvent in condition to go back to the ore vats? Copper precipitated in the form of sulfide generally contains 60 odd per cent. of metal and is, therefore, sufficiently concentrated to be handled in any one of several ways with which metallurgists are familiar.

The use of hydrogen sulfide for metallurgical purposes is no novelty, but the knowledge gained in its application appears to have been temporarily overlooked. It will be recalled that there are a number of methods for producing the gas to choose from, one or the other of which will generally meet local conditions. Those who have investigated the application of the reagent to metallurgical purposes find it replete with interesting possibilities. In any event its use in copper leaching operations suggests one way of avoiding sending 87 per cent. of the copper already extracted from an ore back into the cycle of operations. It also simplifies the removal of copper from discarded solutions.

\* Received Oct. 6, 1919.

That there is room for improvement in leaching processes, as now applied to copper ores, is further evidenced by information contained in the latest annual report of the Utah Copper Co. The operation of the leaching plant of that company is said to have been hampered by an inadequate precipitating and drying system which reduced the rated capacity (3000 tons daily) two thirds. The cost of the copper produced "crediting an allowance for copper in stock solutions, and adding smelting and selling charges" is given as 15.1 c. per lb., with apparently no charge made for mining. If a charge of 45 c. per ton for mining is added the cost of the copper would be increased to 19.3 c. per lb. The leaching plant was closed Jan. 1, 1919, the first department to experience curtailment. Extraction of copper from ore by the use of aqueous solutions has attained a fairly satisfactory stage of development, but the methods in use for removal of the metal from the lixiviant, and its subsequent treatment, can be much improved in some instances.

### Deterioration of Nickel Spark-plug Terminals in Service

Discussion of the paper of HENRY S. RAWDON and A. I. KRYNITZKY, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1323.

FRANCIS B. SILSBE,\* Washington, D. C. (written discussion†).—This paper is an interesting example of the solution by the methods of metallography of what seemed at first a purely chemical problem. The authors have shown, in detail, how the well-known corrosion of spark-plug terminals is due to the dropping out of the individual crystals of the metal as it becomes surrounded by an oxide film. This corrosion is usually quite slow but in special cases may become a serious factor in limiting the life of spark plugs. There still remains the problem for the metallurgist to produce a material that will be entirely free from this trouble.

One of the most startling results of the work is the demonstration that it affords of the deleterious effect of a mechanical stress continuously applied to material that is at the same time subject to adverse chemical or thermal conditions. The particular style of spark plug shown in the illustration, and in which serious trouble was caused by this corrosion, has the side terminals fastened at both ends and the method of assembling is such that a considerable initial tension is applied to the wire. It is without doubt this superimposed tension that causes the inter-crystalline network to line up, as it were, into a few continuous and deeply penetrating transverse fissures instead of forming a great number of shallow surface cracks. This result is clearly shown both in the case of

\* Associate Physicist, U. S. Bureau of Standards. † Received Sept. 18, 1919.

wires suspended in the electric furnace and in the spark-plug terminals themselves.

This phenomenon is closely analogous in some respect to another case of deterioration, which, oddly enough, also arose in connection with the work that the Bureau of Standards has been carrying on during the past two years on spark plugs and ignition apparatus. The second instance is the cracking of the rubber insulation on the high-tension cables connecting the spark plugs to the distributor. The ozone produced by electrical discharges in the neighborhood of such cables attacks unstressed rubber uniformly and very slowly. The presence of a very little mechanical tension in the insulation, however, is sufficient to localize the corrosion into a few deep cracks, which rapidly extend to the core of the cable and render it useless. This failure of the cable and the breaking of the nickel wire described in this paper are doubtless only two of the many similar cases where a material fails under a combination of adverse conditions, no one of which is alone sufficient to cause any serious damage.

### Petroliferous Provinces

Discussion of the paper of E. G. WOODRUFF, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 907.

CHARLES SCHUCHERT,\* New Haven, Conn. (written discussion†).— I embrace the opportunity to take part in a discussion of Mr. Woodruff's paper because a successful discerning of what actually constitutes petroliferous areas from the geologists' standpoint is worthy of our endeavors, not only from the intellectual side, but also because it may lead, as Mr. Woodruff hopes, to the more certain establishment of principles that can be applied to other continents in exploiting them for petroleum. This discussion will also embrace the results of two other recent papers, one by Alexander W. McCoy and one by Maurice G. Mehl.<sup>1</sup>

*Sources of Petroleum.*—Mr. Woodruff is agreed that petroleum comes from plants and animals, or possibly from both, and that it has accumulated by migration into reservoir rocks. These reservoir rocks must of course be porous to become catch basins for the oil and gas, and then, too, their present structures are variable, as they occur in anticlines, domes, terraces, etc. The structures, he states, are more widespread than are the oil pools, and the same is true for the reservoir rocks. Accordingly, there must be many good sands and structures

\* Curator, Geological Dept., Peabody Museum of Natural History.

† Received Sept. 4, 1919.

<sup>1</sup> A. W. McCoy: Notes on Principles of Oil Accumulation. *Jnl. Geol.* (1919) 27, 252-262.

M. G. Mehl: Some Factors in the Geographic Distribution of Petroleum. *Bull. Sci. Lab., Denison Univ.* (1919) 19, 55-63.

that have no petroleum. On the other hand, there are conditions in the making of the hydrocarbons that are not formulated by Woodruff or are not clearly in mind. These are: Petroleum is not formed in sufficient quantities to be commercially available in the fresh-water or subaerial deposits of the lands, the continental deposits. For practical purposes all such should therefore be excluded, at least for the time being, from further consideration. Moreover, land climates have but little direct bearing on the temperature necessary for life in the seas where the petroleum is formed, because there is an abundance of life in all shallow, marine waters of whatever climate. Again, there has been abundant life in the seas of all times, not only since the Cambrian, but ever since the Archeozoic. The proof of this is seen in the high state of organic evolution attested by the earliest Paleozoic fossils, and in the nature of the marine formations of the Proterozoic and Archeozoic strata, with their high carbon content. All of these differences between us will be discussed later.

*Areas With and Without Petroleum.*—Mr. Woodruff is seeking for the regional conditions that originally controlled the formation of the hydrocarbons and their later storage into oil reservoirs. In this way he is led to point out the petroliferous provinces. The conditions that make for oil provinces he holds to be three:

1. The source of petroleum lies in the end-results brought about through the decay of organisms, and the preservation of the residues is limited to certain environmental conditions. There are great areas that have always been devoid of the required life conditions, and others where the entombed organic residues have been dissipated by the deformational processes.

2. Petroliferous areas are limited by more or less definite characters in the oil-preserving and oil-storing strata.

3. Petroliferous strata have more or less definite deformational structures.

The ideas which, in our opinion, lead to the ascertaining of the petroliferous and non-petroliferous rocks of North America are:

1. The impossible areas for petroliferous rocks.

- (a) The more extensive areas of igneous rocks and especially those of the ancient shields; exception, the smaller dikes.

- (b) All pre-Cambrian strata.

- (c) All decidedly folded mountainous tracts older than the Cretaceous; exceptions, domed and block-faulted mountains.

- (d) All regionally metamorphosed strata.

- (e) Practically all continental or fresh-water deposits; relic seas, so long as they are partly salty, and saline lakes are excluded from this classification.

- (f) Practically all marine formations that are thick and uniform in rock character and that are devoid of interbedded dark shales, thin-bedded dark impure limestones, dark marls, or thin-bedded limy and fossiliferous sandstones.
  - (g) Practically all oceanic abyssal deposits; these, however, are but rarely present on the continents.
2. Possible petroliferous areas.
- (a) Highly folded marine and brackish water strata younger than the Jurassic, but more especially those of Cenozoic time.
  - (b) Cambrian and Ordovician unfolded strata.
  - (c) Lake deposits formed under arid climates that cause the waters to become saline; it appears that only in salty waters (not over 4 per cent.?) are the bituminous materials made and preserved in the form of kerogen, the source of petroleum; some of the Green River (Eocene) continental deposits (the oil shales of Utah and Colorado) may be of saline lakes.
3. Petroliferous areas.
- (a) All marine and brackish water strata younger than the Ordovician and but slightly warped, faulted, or folded; here are included also the marine and brackish deposits of relic seas like the Caspian, formed during the later Cenozoic. The more certain oil-bearing strata are the porous thin-bedded sandstones, limestones, and dolomites that are interbedded with black, brown, blue, or green shales. Coal-bearing strata of fresh-water origin are excluded. Series of strata with disconformities may also be petroliferous, because beneath former erosional surfaces the top strata have induced porosity and therefore are possible reservoir rocks.
  - (b) All marine strata that are, roughly, within 100 miles of former lands; here are more apt to occur the alternating series of thin- and thick-bedded sandstones and limestones interbedded with shale zones.

Experience has shown that commercial quantities of petroleum do not occur in areas of igneous rocks, nor in regions of highly folded, mashed, and decidedly metamorphosed strata that as a rule are older than the Tertiary. Nevertheless, it will not do to say, because strata are decidedly folded and faulted, that in the areas of mountains there can be no commercial quantities of oil, for we know that the petroleum fields of the Coast ranges of California and those of the trans-Caspian countries have yielded vast quantities. Here, however, the oil-yielding strata are essentially of Cenozoic age. It appears that the main regions for oil production in North America will be the more or less flat-lying sedimentary formations—the vast geologically neutral area—to the east of the Rockies and to

the west of the Appalachians. Also, in a broad and general way, the older the geologic formations, the more devoid they are apt to be of petroleum; and the more often a given area has been subjected either to mountain folding or to broadly warping movements, the more certain it is that all or most of the volatile hydrocarbons have been dissipated. Such places are apt to have the hydrocarbons only in fixed form and not as kerogen. In strata older than the Cretaceous, the deformed geologic structures of varying sorts should be rather of minor than of major strength as an essential to oil accumulation in commercial quantities.

*Original Oil Strata.*—It appears that zones of petroleum, in general, do not occur in thick deposits that are continuously of the same kind of material, as sandstones, limestones, or shales, but in or near sandstones and thin-bedded porous limestones that are interbedded with bituminous shales. McCoy says that in the mid-continent field the petroliferous shales "are generally dark colored, often black, and carry bands of highly bituminous material." Such bands "are often described by the drillers as coal, asphalt, or black lime, according to the hardness and appearance of the material. The shales are typical oil shales, quite similar in character to those (of the Cenozoic) of Colorado and Utah."

*Petroleum of Organic Origin.*—The hydrocarbons are the chemical end-results of organisms and, in the main, are the fatty substances derived through bacterial decomposition from the plants and animals once living in the sea waters. This is a conclusion not always clearly in the minds of petroleum geologists.

One is led, Dalton<sup>2</sup> states, "to regard the great majority of oils as derived from the decomposition during long ages at comparatively low temperatures of the fatty matters of plants and animals, the nitrogenous portions of both being eliminated by bacterial action soon after the death of the organism. The fats and oils from terrestrial fauna and flora may have taken part in petroleum formation, but the principal role must, from the nature of most petroliferous deposits, have been played by marine life."

The decomposition bacteria attack the cellulose of the plants and the nitrogenous tissues of animals, leaving untouched the fatty materials. The reason why the fats remain untouched is probably because the feeding of the bacteria is stopped by sedimentation, which buries and kills the decomposing organisms living beneath the surface of the sea bottom. Dalton further states that "Peckham's view, that asphaltic oils are mainly of animal origin, while paraffin is largely derived from vegetables, is worthy of acceptance on general chemical as well as geological grounds, since Krämer and Spilker, and others, have shown that vegetable fats produce paraffin either with or without artificial distillation, and the

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<sup>2</sup>Leonard V. Dalton: On the Origin of Petroleum. *Econ. Geol.* (1909) 4, 603-631.

limestone oils, which on geological grounds are generally held to be mainly of animal origin, are notably asphaltic." In general, the Palæozoic petroleum has paraffin bases, and it seems probable that all those derived from black petroliferous shales are largely, if not wholly, of marine algal origin. Usually we do not realize the extraordinary importance and abundance of plant life, but when we think that all animals are in the ultimate dependent for their existence upon plants, we begin to perceive the truth of the following forceful statement by the English botanist, F. F. Blackman,\* who recently said that "Botany, as the science of plants, claims dominion over some 99 per cent. of the living matter on the surface of the earth and over most of the fossil remains 'under the surface.'"

*Petroleum Essentially of Marine Origin.*—It is, however, plain to all who have looked into the matter that petroleum cannot accumulate upon the dry land in deserts, grassy plains, or forests, for here the oxidizing influences are so active that all the volatile parts must be taken away or completely changed. In lakes, organic decay is, as a rule, so rapid that limy marls are deposited, and it seems to be exceptional that black petroliferous muds are of fresh-water origin. The extensive oil-shale deposits of the Green River series of Utah and Colorado are certainly not of marine origin, as they are devoid of marine organisms and are underlain and overlain by river flood-plain deposits of early Eocene age, as is shown by their contained land animals and plants. The hydrocarbons appear to be of drifted plant origin, according to Charles A. Davis, and as kerogen does not form in large quantities, the evidence appears to indicate that the water in which the Green River shales were deposited was slightly saline. Therefore the chemical end-result of organic decay, the kerogen, cannot accumulate in commercial quantities except beneath a sheet of salt water, and these sheets of water probably are in the main within the limits of a few hundred feet of depth; the deeper the water basins, the more certain the amount of oil accumulation, under these given conditions. Salt water and organisms are the first requisites for kerogen making in nature and, accordingly, the hydrocarbons are stored almost always in marine sediments; these are chiefly the black and brown shales and the impure dark thin-bedded limestones. All rock formations accumulated directly beneath the atmosphere, as the pure continental deposits, must therefore be devoid of commercial quantities of petroleum. Then, too, all deposits, either of the fresh waters or of the seas, which are periodically subjected to atmospheric weathering during their time of accumulation, are also lacking in oil in paying quantities. Hence we may further conclude that all red or reddish, yellowish or white, rain-pitted or sun-cracked deposits, either of conti-

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\* *New Phytologist* (1919) 18, 58.

mental, fresh-water, or semi-marine origin, are lacking in petroleum in large amounts.

McCoy informs me that an average oil shale yields, at temperatures between 500° and 1200° F. (260° and 648° C.) about 20 gal. (75 l.) of oil, and from 15 to 18 lb. (6.8 to 8.1 kg.) of ammonium sulfate per ton of shale. In the spent shale there still remains from 15 to 20 per cent. of fixed carbon, but no ammonium sulfate. The bituminous material in unspent shales, he states, "occurs in solid form, as none of the ordinary solvents show coloration after solution tests. Upon distillation, such shales have given off petroleum." This "solid organic gum called kerogen" can be changed in the laboratory to liquid hydrocarbons by heat. In nature, this may be brought about possibly by intense friction developing heat, but more probably only in deep-seated water-bearing strata—accordingly, in formations that are under greater pressure. However, "pressure alone can cause no change in this material when the included water is not allowed to escape." On the other hand, "the maximum static pressure available in any porous zone is a function of the size of the openings around that stratum. The determining factor is the capillary resistance of the water in the adjoining small openings." In other words, the solid kerogen "is only changed to petroleum in local areas of differential movement. . . . After such a change is made, the accumulation of oil into commercial pools is accomplished by capillary water; and the interchange only takes place in local areas where the oil-soaked shale is in direct contact with the water of the reservoir rock. Such conditions are explainable either by joints or faults." A. B. Thompson, however, in "Oil Field Development," states that, according to the observations of C. W. Washburne, "since water has a surface tension of about three times that of crude oil, capillary attraction exerts about three times the force on water that it does on oil. As the force of capillarity varies inversely as the diameter of a pore, it is contended that this force tends to draw water into the finest tube in preference to oil and displaces contained oil and gas: the result being that oil would be expelled from fine-grained material like clays into coarse-grained beds like sand."

How thick must a petroliferous shale be to furnish the necessary amount of oil for a productive field? McCoy states that "the amount of oil in any producing field could have been derived entirely from shales immediately surrounding the oil sand. A series of shales aggregating 10 ft. (3 m.) of bituminous sediment, yielding 25 gal. (94 l.) to the ton, would furnish 17,000 bbl. of oil per acre. Assuming a 25 per cent. extraction, the acre yield would be over 4000 bbl. The average acre yield in Oklahoma and Kansas ranges from 2500 to 3000 barrels."

Petroleum is probably forming today in many marine waters. Dalton says it is present "in the mud of the Mediterranean sea-floor between Cyprus and Syria. . . . It was also found in the Gulf of Suez, and in

each case ammonia and iron sulfide or sulfur occur with the oil." Potonié showed its presence in the Gulf of Stettin, Germany, and Fritsch showed that humus is forming rapidly in the salt marsh in the Bouche d'Erquy, Brittany. In all these cases, the muds are of the black, putrid type that Potonié calls sapropel. Why, then, does petroleum not occur more uniformly in the geologic deposits? Because the hydrocarbons universally tend to escape into the air or water from which they were originally taken by the living entities. Muddy waters with the finest of silts and not too much agitated by currents or winds are the places where the hydrocarbons naturally may accumulate, because here the organic fats and oils have great affinity for, and unite with, the minute clay flakes, and are thus held in more or less solid form and deposited as kerogen with the shale formations. Evidently, the hydrocarbons can accumulate and be preserved in large quantities only in areas of argillaceous sedimentation. Therefore, in order to accumulate petroliferous deposits, the waters must have life in them; and the freer they are from oxygen, the more certain will be such accumulations. On the other hand, almost all life fails to exist where there is no oxygen, because oxygen is the first essential of nearly all life, and where the petroliferous materials are gathering in greatest quantities, there the waters are free of this gas and the bottoms are black and foul—putrid muds reeking with odors. Where, then, does the life come from in these places of hydrocarbon-gathering? It develops in great abundance in the sunlit, agitated, and oxygenated surficial areas of the water basins, and after death the organisms rain into the deeps, where they very slowly decompose, due to peculiar forms of bacteria existing in the stagnant waters that are depleted of oxygen. Are the surficial waters the only source for the life that is gathered into the oil shales? No. The life may develop hundreds of miles away from the place of accumulation and be drifted by winds, or by tidal or even oceanic currents into bays, cul-de-sacs of the seas, and into the shallow but extensive depressions on the sea bottoms. The petroliferous deposits are accumulating today in greatest amount in the shallow waters bordering the lands rather than in the greater depths.

However, not all shales are oil shales. As all geologists know, about 80 per cent. of the sedimentaries are mudstones, and yet petroliferous shale formations are not common. If forced to guess what percentage of shales are decidedly petroliferous, I should reluctantly say probably not more than 10 to 15 per cent. The combination of conditions necessary to deposit an oil shale is present in but few bays or other deeper, stagnant areas where clay muds are collecting. Therefore the importance to all petroleum geologists of knowing the nature of the sedimentary formations of the areas they seek to exploit.

The rich oil shales of Utah and Colorado appear to be of fresh-water origin—shallow lakes that existed in Eocene time. We are told that

they yield on distillation up to 90 gal. (340 l.) of oil, about 18 lb. (8 kg.) of ammonium sulfate, and up to 4500 cu. ft. (126 cu. m.) of gas per ton of shale.<sup>4</sup> This is the only striking occurrence known to me of fresh-water deposits in North America with an abundance of hydrocarbons. The organic materials are, in the main, plants and their present condition suggests peat deposits. But we must again point out that the age of the rocks is comparatively recent (Green River = early Eocene), and that they have undergone but one slight deformation. Therefore the kerogen still remains.

*Abundance of Life Necessary to Petroleum Gathering.*—The petroleum geologist thinks that there must have been a vast abundance of life to make such great storages of oil as are now still present in the shales. In this he is undoubtedly correct, but what he does not keep in mind is the long time it has taken to accumulate the black shales. Accordingly, the quantity of life necessary to oil accumulation need not be so vast at a given time as he thinks. On the other hand, he holds that life did not become abundant enough to result in petroliferous deposits until Middle Paleozoic time. In this connection it should be said that paleontologists have long been familiar with an abundance of macroscopic fossils in rocks dating from the very beginning of Cambrian time and hence from the beginning of the Paleozoic. The seas ever since that period have been filled to their limit with life, microscopic and macroscopic, and in constantly increasing variety. What the geologist sees and gets are the larger fossils; but for every one of these individuals there certainly existed hundreds of thousands and probably millions of invisible plants and animals. It is this minute life, and especially the plants, that is so important in the life cycle, for these microscopic organisms make alive in their bodies the inorganic materials on which they feed. The micro-plants are the basis not only of the subsistence of all the animals of the seas and oceans but, what is equally as important, the accumulation of the hydrocarbons. In this connection we may also add that the almost pure chemically precipitated limestones are due to the metabolic processes of minute plants, the denitrifying bacteria. Accordingly, it is the invisible, and not necessarily the visible, fossils that have gone to the making of the petroliferous deposits of the geologic ages. Most of these forms are short-lived and propagate quickly and in prodigious quantities; the great majority pass through the life cycle in from a few hours to a few days or at most a few months. In this way they make up in quantity what they lose in individual size.

We know of some animal fossils in the late Proterozoic, and even though they are as yet few in number, their high organization teaches unmistakably that there was a host of greatly varying organisms. Of

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<sup>4</sup> Dean E. Winchester: U. S. Geol. Survey, *Bull.* 641-F (1916).

lime-secreting algal plants in the Proterozoic, we know vastly more; and from the course of all organic evolution as revealed by the living world, supported by the chronogenesis of the geologic past, we can safely state that at all times, even as far back as the beginning of the Archeozoic as now known in the oldest of geologic deposits, there must have been an abundance of life in the waters of the earth. Hence the abundance of graphite in the Archeozoic and the vast amounts of dark carbonaceous strata in the Proterozoic. Even so, it is hardly probable that commercial quantities of petroleum will be found in the rocks of the Proterozoic, and certainly none at all in those of the Archeozoic, because these very ancient deposits have either been subjected to frequent deformation, or because, due to their great antiquity, the volatile hydrocarbons have long since been liberated into the atmosphere.

*The Climatic Factor in Petroleum Making.*—The question of land climates probably does not enter at all into the matter of petroleum accumulation, because it is not in the land deposits that the commercial quantities of oil are found. As has been said before, the oils occur nearly everywhere in marine deposits and only rarely in fresh-water ones. This being so, and as the marine shallow waters of today abound in life, whether in the warm, cool, or coldest areas, it follows that we may look for petroliferous formations in almost all continents where the ancient oceans have spilled over them; and this without paying much attention to the changing climates of geologic time. On the other hand, as the greatest amounts of carbon and carbonaceous deposits occur in the north temperate belt, we should seek here in the main for the petroliferous strata. This does not mean that petroleum is absent in tropical lands—far from it. It only points out that the greater quantities will not be found in the deposits of former tropical seas, and for reasons to be set forth.

Since the previous paragraph was written, there has appeared the suggestive paper by Mehl, already cited, in which he points out that all of the major oil fields of the world are situated between 20° and 50° north latitude. Further, that there are no major oil areas within the tropics or in the southern hemisphere. As the known major oil fields lie between the present isotherms of 40° and 70° F., he thinks this distribution “does suggest a distinctly zonal distribution of petroleum in which temperature may have been an important factor.” The question that here arises is, Is this suggestion of present climatic conditions also true for the times when the oil was deposited in the strata in which it is now found, remembering that the oil fields were not made recently but are the accumulations of hydrocarbons of the seas of the geologic ages? The answer is not at all in harmony with Mehl’s suggestion, for we are living in an exceptional time of stressed climates and marked zonal conditions, while the mean temperature conditions during the geologic ages were warm and equable

throughout most of the world. And this is even more true of the temperature of the oceans than of the lands. This being so, much of the value of Mehl's surmise falls away. On the other hand, it is undoubtedly true that high temperatures in clear waters and well oxygenated seas make, as a rule, for complete destruction of the volatile hydrocarbons, while those of temperate waters in currentless and muddy areas tend to preserve them. The temperature factor, when high, appears to be destructive of volatile hydrocarbon preservation, but in this connection it should not be forgotten that the seas are far more equable in temperature than are the lands, and that during most of geologic time the seas were far more equable in heat content than they are today. This is thought to mean that the ancient tropical seas were somewhat less warm than they are now, while those of the polar areas were no colder than the present temperate shallow-water areas. Corals were common in Alaska in Silurian and Devonian times, corals and warm-water fusulinids lived in the Carboniferous in Spitzbergen, and there were magnolias and bread-fruit trees in Greenland during the middle Tertiary. The writer also knows that hydrocarbons have accumulated in large amounts in seas within the tropics, yet seemingly the amount is far the greatest in what is now the north temperate zone. That this zone has the greatest amount of petroleum is apparently due wholly to the greater land masses here, along with the necessary storage strata accompanied by the proper amount of deformation.

Even if Mehl's suggestion were correct, and we should accordingly think of next exploiting the temperate region of the southern hemisphere, we must not overlook the fact that the northern hemisphere is the land hemisphere, while the southern one is the water hemisphere, and therefore has greatly reduced continents. Therefore between latitudes 20° and 50° south we have only the attenuated southern half of South America, the southern tip of Africa, the southern half of Australia, and New Zealand. Southern Africa and most of Australia are, furthermore, continental nuclei or "shields" and therefore have hardly at any time been under the sea, but in regard to South America the story of marine submergence is very different. Even now petroleum fields are known in Peru ("one of the finest oil fields in the world," according to Thompson), Bolivia, and Argentina. Then, too, the fact should be emphasized that "shields" are largely made up of pre-Cambrian rocks and therefore are barren of petroleum.

In regard to Mehl's other suggestion of a "barren equatorial belt," I am inclined to believe that he is correct in the main; not, however, on the ground of temperature and climate, but on that of the tectonic geologic and physiographic conditions of the continents. On the other hand, attention should be directed to the fact that productive petroleum fields occur in the Tertiary strata of the tropical zone in the Lake Mara-

caibo area of Venezuela, and in the Caribbean Piedmont of Colombia, Trinidad, and Ecuador. Further, highly productive fields are those of the Indo-Malay region, in Java, Borneo, Ceram, and New Guinea. We know that Africa is a continent that was more continuously high above the strand-line than any other, and is loaded with continental deposits, while South America and more especially Australia are not especially rich in marine sediments, and when these are present they have been subjected to mountain-making to such an extent that all of the volatile hydrocarbons have long since vanished into the air or been transformed into fixed carbon. In the northern hemisphere, most of Asia east of the Caspian has also been too much the seat of crustal movements to have much petroleum accumulation in the Mesozoic and Paleozoic formations. From these observations, it appears that the northern hemisphere will always remain the greater for favorable petroleum possibilities.

In all that has so far been said, the statements relate in the main to folded continental masses, but as some most wonderful oil fields, like that of the Baku area in Trans-Caucasia, are of very small extent, it follows that many restricted and highly productive fields are possible even in areas of decided crustal movements, but I should look for such places only in regions of Cenozoic marine formations, and mainly in Asia.

*Paleogeography as an Aid in Locating Oil Areas.*—The importance of paleogeography in petroleum geology is as yet but little appreciated. Foul sea bottoms, where the hydrocarbons accumulate, and sandstones, in which they are stored, are usually connected with nearness to land. Their physical characters have to do with shallow seas and more especially with headlands, off-shore spits and bars, barrier beaches and river mouths, which divert and from time to time change the currents of the sea. On the other hand, the open seashores, with their more or less long "fetch of the winds," are the washeries of the land-derived detritus. Here the cliff-derived materials are broken up by the waves of the seas in their grinding mills, and the finer erosion materials of the weathering lands, brought by the rivers, are assorted and reassorted many times according to specific gravity and size of grain. The coarsest material lies on the strand and near the shore, and seaward the material becomes, broadly stated, finer and finer of grain. All of this assorting and sea-transporting depends on the size of the waves "kicked up" by the winds, and the shallowness of the waterways. It makes no difference whether it is long or short rivers that deliver the unassorted muds and sands to unagitated and stormless seas, the deposits will be neither petroliferous-making areas nor good rock reservoirs for oil. If, however, such materials are delivered into the open and stormswept seas, there will be assorting according to size of grain, and the sandbars will make headlands behind which current-less waters will accumulate the hydrocarbons. In all this we see that as the places of natural hydrocarbon manufacture and its

future storage are conditioned by the nearness of the shore and the depth of water, it behooves petroleum geologists to pay close attention to the discerning of the myriads of constantly changing geographies of the geologic past.

*Petroliferous Provinces.*—We have now defined the essential principles that underlie, in nature, the gathering of petroleum in commercial quantities and can next consider the question, What constitutes a petroliferous province? Clearly it cannot be merely an area that produces oil, because the word province is significant of embracing things more or less of a kind. Shall the criterion be whether the area has solid or fluid-gaseous hydrocarbons? Or whether the strata are dry or wet? Probably neither. Shall it be the nature of the oil, whether it is light or heavy? Probably not. Seemingly it should rather be the age and time of deformation of the strata having oil, combined with their governing structures. In other words, the classification should express the chrono-orogenetic origin of the oils. For instance, in the Ohio Basin province, a subprovince would be the oil fields in the vanishing Appalachian folds along the western side of the Allegheny area; another, the eastern Ohio oil fields; and a third, the Trenton area of Ohio and Indiana. A beginning in such mapping has been made by Johnson and Huntley in their "Oil and Gas Production," plates 91 and 92. However, in the course of time we shall here, as in other studies, undergo an evolution in our classifications.

In general, Mr. Woodruff's map and plate 92 of Johnson and Huntley bring out the areas of worth-while exploiting, those of improbable value, and the regions that can have no petroleum. However, these maps are so small that other and even more essential features cannot be depicted; these are the structural trend lines, the periodically rising areas or "crustal highs," the long-enduring ancient lands and their shore-lines, and whether the region has strata of more than one era. Of course, all of these things cannot be plotted on a single map, however large, but until this is done on a series of maps, we cannot define what are the genetic characteristics of each petroliferous province and the proper guidance to its exploitation. ✓

The most important of all geologic problems connected with oil exploitation, the geologic structures, will not be discussed here. Among the most important maps necessary for the broad guidance of petroleum geologists is one to show the "highs" or positive areas and the deformational structure lines, drawn in symbols according to geologic age, *i.e.*, to show the trends of the mountain folds, the many low axes, like the Cincinnati axis, and the greater fault lines. Such a map, of even a limited area, would be a prophetic guide to oil exploitation in the region so mapped.

Can such highly desirable maps be made quickly? Naturally no one geologist can alone make such maps of the North American continent,

or even of the United States. They can be made only through coöperation. A special commission for this work should be organized by the larger oil companies and a philosophical study made of all of the geologic problems involved in petroleum discovery. For this we have an example in the study of the principles underlying copper genesis made by the copper-producing companies of the United States, at a cost of about \$50,000. A similar contribution by the oil companies would go far and might, even in a few years, make all of the required generalizing maps. But will the companies believe in these possible solutions, and that they will undoubtedly lead to a more certain and a more constantly successful exploitation of petroleum in North America? We have faith in our prophecy, but will the operators have faith in the prophets?

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### Height of Gas Cap in Safety Lamp

Discussion of the paper of C. M. YOUNG, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1207.

H. G. DAVIS,\* Wilkes-Barre, Pa. (written discussion†).—The only practical method of testing mine air for gas, until recent years, was by the effect of the gas on the flame of the ordinary Davey Lamp, and it is quite surprising how nearly the correct percentage of gas can be determined by many men by observing the behavior of the safety-lamp flame in the different mixtures. Mine foremen frequently guess the percentage of gas to within 0.1 per cent., making certain allowances to cover the dust-laden atmosphere, in which the test was made. It is not meant by this that anthracite dust is explosive, but that its properties increase the length of a fuel cap on an ordinary oil-burning lamp, which, as Prof. Young contends, increases in height with the proportion of gas and increased temperature.

Naphtha or benzine-burning lamps have a hotter flame, and, therefore, are more sensitive so that a smaller percentage of gas can be detected. Some of the fire bosses in this region some years ago preferred the Koehler lamp, while others did not care to use it in their morning examinations.

In 1911, when the experimental mine of the Bureau of Mines at Bruce-ton, Pa., was being prepared to be exploded, a large number of mining men went through it to examine the entries, which were lighted by electricity. While so doing, they saw in the face-return-airway a Koehler or Wolfe lamp, that seemed to be burning with difficulty. An investigation showed that the lamp had been filled to overflowing with naphtha and was generating this surplus gas. This shows how easily we can be

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\* Lehigh and Wilkes-Barre Coal Co.

† Received Sept. 11, 1919.

deceived so that it is more difficult to decide by observation the percentage of gas contained in the atmosphere by the length of a cap of a naphtha-burning lamp, than of the cap of an ordinary oil-burning lamp.

Professor Young states that the object of his experiment was not to find the exact height of a cap given with a certain percentage of gas at a given temperature of the coil. He also states that with a gas mixture equivalent to 4 per cent. methane no cap was observed at 660° C., but that a cap of about  $\frac{3}{8}$  in. was observed with a 4 per cent. mixture at a temperature of 662° C. To the practical miner, this means little, as the only method of detecting gas at his command is the flame of the safety lamp, which provides the necessary temperature at all times.

It is interesting, however, to learn from the experiments conducted by Prof. Young that if the temperature of gaseous mines can be kept down the danger from gas explosions is somewhat decreased: the one practical way of keeping down this temperature is by keeping the mine well supplied with an adequate quantity of good fresh air.

The United States Bureau of Mines some time ago prepared a chart on the properties of gases, from which the following is quoted.

| CAP, IN INCHES | PERCENTAGE | CAP, IN INCHES | PERCENTAGE |
|----------------|------------|----------------|------------|
| 0.20           | 1.5        | 0.47           | 3.0        |
| 0.15           | 2.0        | 0.75           | 3.5        |
| 0.35           | 2.5        | 1.15           | 4.0        |

I readily agree with Prof. Young that to determine the heights of gas caps with any degree of accuracy is, indeed, a rather difficult problem, especially if there is any velocity or movement of the ventilating current. It never occurred to me that temperature was such an important factor in the composition of our mine gases; this, however, is very satisfactorily demonstrated by the paper.

While the writer was superintendent of the D. L. & W. mines, a miner left an ordinary Davey lamp in the face of a gaseous place and, later, on returning to the place, found the burning lamp filled with gas and red hot. He at once ran out of the place and sent word to the surface, as he was on the night shift. The writer and the mine foreman were notified and hurried to the mine expecting to find the place blown up. Entering the mine we advanced very cautiously until we reached a point from which the lamp could be observed. We had been told that the 16-ft. canvas in the face had fallen and that a considerable amount of gas had accumulated. This we later found was not true. After a thorough study of the situation, it was suggested that a wet feed bag be wrapped around the burning lamp, which could then be removed to the mouth of the gangway. This was successfully accomplished. When the burlap, which was steaming hot, was unwrapped, it was found that the gauze had

been burnt so that when touched it fell to dust: very much like that of a gas mantle.

A fire boss in one of the mines of this region had a similar experience. A miner, whose place was only a short distance from the gangway road, forgot to take down his safety lamp when leaving for home and the driver, after passing through the canvas with the gangway car, forgot to replace the same, with the result that gas quickly gathered near the lamp, which, strange to say, burned until found by the fire boss when he made his morning round. After a study of the situation, he climbed the pitch until he could reach the lamp with his pole, when he carefully removed it. The gauze in this lamp also was found to have been burnt to a white ash.

These cases are cited to show that a safety-lamp gauze will not necessarily pass the flame and ignite the surrounding gas, as we have always been taught. I will admit, however, that these cases are not common. The movement of the lamps themselves, or the surrounding atmosphere would, no doubt, result in passing the flame.

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## Book Review

**THE IRON HUNTER.** By Chase S. Osborn, pp. 316, Ills. 10. The MacMillan Company, New York. 1919.

An autobiography, the story of a Hoosier boy who fought his way to manhood and power through early misfortune and poverty, from street urchin and newsboy, to editor and author; from lumberjack and dock walloper to statesman and Governor of Michigan. The reader has the measure of the man in the first chapter, a dramatic recital of how the fighting boy editor cleaned up a lawless mining camp of 40 years ago. The thread of the narrative is the author's life-long devotion to outdoor living, exploration and travel. Residing in Sault de Sainte Marie, Mich., in the heart of the Lake Superior country, he took his delight and, incidentally, found his fortune in prospecting the north woods for iron ore; eventually, extending his travels to the continents and many of the islands of the world, he discovered what he believes to be a great iron range in Madagascar.

In this book there is plenty of anecdote, a great deal of wholesome social and political philosophy and some interesting sidelights on the characters of some of the author's prominent contemporaries in the political life of Michigan. The style is direct and animated, flavored and illuminated with the vernacular of Hoosierdom and the woods country of the North. The author levies on the vocabulary of the sciences and the classics for many a noun and adjective and, with Rooseveltian license, now and then coins a word. The reader's interest will be gripped from cover to cover, albeit he may occasionally need a dictionary.

R. C. A.

## Book Notices

**APPLIED MECHANICS.** By Fuller and Johnson. Vol. II. Strength of Materials. 1st edition. N. Y., John Wiley and Sons, Inc., Lond., Chapman & Hall, Ltd., 1919. 556 pp., illus., 9 × 6 in., cloth, \$3.75.

Vol. 1 of this text-book, treating of statistics and dynamics, appeared several years ago. The present volume, treating of the strength of materials, covers the fundamentals of this subject, as taught in the engineering departments of the Massachusetts Institute of Technology, in so far as they are required in the study of structural and machine design and in the ordinary problems of engineering practice.

**CHILTON TRACTOR INDEX.** July, 1919. Published semi-annually by the Chilton Co., Phila., 500 pp., 10 × 7 in., paper, \$1.

This is a directory of the American tractor industry, in which, the editors state, they have attempted to present all the information useful to the industry as a whole. It includes descriptions of power farm machinery, illustrated descriptions and specifications of tractors and farm implements, and directories of manufacturers of implements, tractors, parts and accessories.

**CONCRETE-STEEL CONSTRUCTION. Part I. Buildings. A Treatise upon the Elementary Principles of Design and Execution of Reinforced Concrete Work in Buildings.** By Henry T. Eddy and C. A. P. Turner. 2d edition. Minneapolis, C. A. P. Turner and Co., 1919. 477 × 25 pp., illus., tab., 9 × 6 in., cloth, \$10.

The authors of this volume believe that the fundamental principles underlying the theory of reinforced construction are not generally understood by engineers and that the methods of computation of applied bending moments in common use are erroneous. Their book presents what they believe to be the correct analysis of the bending and twisting moments present in columns and flat slabs, a method founded upon the manner of distribution of the vertical shears that transmit the load to the supports.

**CONDENSED CHEMICAL DICTIONARY.** A reference volume for all requiring quick access to a large amount of essential data regarding chemicals, and other substances used in manufacturing and laboratory work. Compiled and edited by The Editorial Staff of the Chemical Engineering Catalog. N. Y., The Chemical Catalog Company, Inc., 1st edition, 1919. 525 pp., 9 × 6 in., cloth, \$5.

The information given includes variant names, formulas, color and properties, constants (boiling and melting points, specific gravity, etc.), derivation, method of purification, grades obtainable, containers, uses, fire-hazard and shipping regulations. Substances made in America are indicated. The volume is fully cross-indexed, and includes a number of useful tables of weights and measures, thermometric scales, etc. Synthetic dyes are omitted.

**FOUNDRY PRACTICE. A Text-book for Molders, Students and Apprentices.** By R. H. Palmer. 2d edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 390 pp., illus., 40 tab., 8 × 6 in., cloth, \$3.

This volume is intended primarily for purposes of instruction, rather than as a treatise for experienced foundrymen. The various types of molds are explained and illustrations of the different practices are given. Cupola and air-furnace practice, foundry equipment, methods of mending and cleaning castings are also discussed. This edition has been enlarged by the inclusion of methods for casting and molding a number of additional articles, such as engine cylinders, propellers, lathe beds and large kettles.

**GEODESY: Including Astronomical Observations, Gravity Measurements, and Method of Least Squares.** By George L. Hosmer. 1st edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 368 pp., illus., tab., 9 × 6 in., cloth, \$3.50.

The author has endeavored to produce a text-book adapted to a course of moderate length which would make clear the underlying principles and emphasize the theory as well as the details of field work. The methods of observing and computing given are consistent with the practice of the Coast and Geodetic Survey.

**IRON AND STEEL. A Treatise on the Smelting, Refining, and Mechanical Processes of the Iron and Steel Industry, including the Chemical and Physical Characteristics of Wrought Iron, Carbon, High-speed and Alloy Steels, Cast Iron, and Steel Castings, and the Application of These Materials in Machine and Tool Construction.** By Erik Oberg and Franklin D. Jones. 1st edition. N. Y., The Industrial Press; Lond., The Machinery Publishing Co., Ltd., 1918. 328 pp., illus., 9 × 6 in., cloth, \$2.50.

This volume, the authors state, is not intended as a treatise for metallurgists and those engaged in the manufacture of iron and steel, but as a text-book for students in technical schools and those engaged in mechanical engineering and machine building.

**MANUFACTURERS' INSTRUCTORS AND ADVISERS.** By Frederic Meron. N. Y., Theo. Audel & Co. (copyright, 1918). 3 vols. and portfolio, cloth, \$7.

**CONTENTS:** No. 1, Layouts and equipments for factories. 228 pp. and portfolio of 34 plates. No. 2, Common sense working methods in factories. 161 pp. No. 3, The human element in organizations, 351 pp.

The author endeavors to present concisely and clearly the results of his experience in the installation, organization and operation of industrial plants, with the object of showing, by comparison and illustration, methods for increasing output and reducing expenses.

**METALS OF THE RARE EARTHS.** By J. F. Spencer. Lond. and N. Y., Longmans, Green & Co., 1919. 279 pp., diagrams, tables, 9 × 6 in., cloth, \$4.50.

This volume supplies a review of our knowledge of these metals, in which their occurrence, separation, compounds and uses are described. An extensive list of references is included, which contains, the author believes, all the important papers published on the subject, as well as most of those of lesser importance.

**OSMOTIC PRESSURE.** By Alexander Findlay. 2d edition. Lond. and N. Y., Longmans, Green and Co., 1919. 116 pp., illus., tab., 9 × 6 in., cloth, \$2.15.

This monograph gives an account of the theories of osmotic pressure, the methods of determining it, and the general theory of solutions. An extensive bibliography is included. In preparing this new edition, account has been taken of the results obtained by investigators during the past six years.

**PRINCIPLES OF ELECTRIC WAVE TELEGRAPHY AND TELEPHONY.** By J. A. Fleming. 4th edition. Lond. and N. Y., Longmans, Green and Co., 1919. 707 pp., illus., pl. tab., 9 × 6 in., cloth, \$14.

Dr. Fleming's well-known treatise has been again revised by additions which bring it up to date, while antiquated matter has been deleted in order that the volume might not become unwieldy. The book is a statement of principles rather than a full account of actual apparatus, and is intended to provide a comprehensive view of the subject, particularly with regard to its scientific side, and of that part of it which is concerned with quantitative measurements and the underlying theory.

#### Accessions

**A-B-C OF COST ENGINEERING.** By Robt. S. Denham. (Gift of author.)

**ALLOYS OF CHROMIUM, COPPER AND NICKEL.** By Oscar Edw. Harder. 1915.

**AMERICAN METRIC ASSOCIATION.** 3d Annual Report. 1918.

**METRIC WEIGHTS AND MEASURES.** 3d edit. 1919. (Gift of American Metric Association.)

**ANNUAL REPORTS OF THE PROGRESS OF CHEMISTRY FOR 1904.** Vol. I.

**ANNUAL REPORTS OF THE PROGRESS OF CHEMISTRY FOR 1905.** Issued by the Chemical Society. Vol. II. London.

**ANNUAL REPORTS OF THE PROGRESS OF CHEMISTRY FOR 1918.** Vol. XV.

**BALBOING DOWN THE PACIFIC.** By Raleigh P. Trimble. (Gift of author.)

**CALIFORNIA,** Third Annual Report of the State Oil and Gas Supervisor of. 1917-18. Bulletin No. 84. California State Mining Bureau. (Gift of Fletcher Hamilton, State Mineralogist.)

**CAMBRIA STEEL.** A handbook of information relating to structural steel. 1919. (Gift of Cambria Steel Co.)

**CENSUS OF MANUFACTURES.** 1914. Vol. 2. Washington, D. C. (Gift of Census Bureau.)

- COLLOIDAL FUEL, COMPOSITES OF OIL, TAR AND CARBON. Problem of Combining Coal with Petroleum Fuel-oils and with or without Coal Tars, Now Solved. By Lindon W. Bates. (Gift of author.)
- COLLOIDAL FUELS, THEIR RELATION TO COAL, TO THE PRODUCTION OF POWER AND HEAT AND TO FIRE PREVENTION AND INSURANCE. By Lindon W. Bates. August, 1919. (Gift of author.)
- COMMERCIAL CONTROL OF THE MINERAL RESOURCES OF THE WORLD: ITS POLITICAL SIGNIFICANCE. By J. E. Spurr. Reprint. 1919. (Gift of author.)
- DEWEY SYSTEM OF CLASSIFICATION AS APPLIED TO MINING, AN EXTENSION OF THE. (Gift of Colorado School of Mines.)
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- DEUTSCHER AUSSCHUSS FÜR EISENBETON. Nos. 12-29, 1911-14.
- ECONOMIC MINERALS AND MINING INDUSTRIES OF CANADA. Mines Branch, Dept. of Mines. 1914.
- EL SANEAMIENTO RURAL DE LA COSTA PERUANA. By Dr. Carlos Enrique Paz Soldan. 1919. Lima. (Gift of Sociedad de Ingenieros.)
- ENGINEERING PRACTICE, THE J. E. ALDRED LECTURES ON. 1918-19. Johns Hopkins University, Department of Engineering. (Gift of the Department.)
- FOSSIL FORAMINIFERA OF THE BLUE MARL OF THE CÔTE DES BASQUES, BIARRITZ. By Edward Halkyard. 1919. Manchester. Reprint. (Gift of Manchester Literary and Philosophical Society.)
- FRENCH METALLURGICAL POLICY ON THE LEFT BANK OF THE RHINE. From the recent book, *Le Fer sur une Frontière*, by Fernand Engerand. 1919. Trans. by Sir Robt. Hadfield. (Gift of Sir Robt. Hadfield.)
- HYDRO-ELECTRIC POWER COMMISSION OF THE PROVINCE OF ONTARIO. 1918. Vols. 2 and 3. Annual Report. (Gift of Commission.)
- INDEX OF ECONOMIC MATERIAL IN DOCUMENTS OF THE STATES OF THE UNITED STATES. By Adelaide R. Hasse. Publ. by the Carnegie Institution of Washington, Kentucky, New Jersey, California & Ohio. 5 vols.
- INDIANA GEOLOGY AND NATURAL RESOURCES. 22d Annual Report. 1897. 26th Annual Report. 1901.
- INDUSTRIAL COUNCIL PLAN IN GREAT BRITAIN. Reprints of the Report of the Whitley Committee on Relations between Employers and Employed of the Ministry of Reconstruction and of Related Documents.
- INDUSTRIAL RESEARCH. By Frank B. Jewett. 1919. Reprint. (Gift of author.)
- INTRODUCTORY LECTURE TO THE CLASSES IN METALLURGY IN THE ROYAL TECHNICAL COLLEGE, GLASGOW, at opening of the Session, 1918-19. By Prof. Cecil H. Desch. (Gift of author.)
- IOWA GEOLOGICAL SURVEY, BULLETIN No. 6. The Raptorial Birds of Iowa. By Bert Heald Bailey. 1918. (Gift of Survey.)
- LAW OF GOVERNMENT CONTRACTS. By R. Preston Shealey. N. Y. 1919.
- MACHINERY VERSUS TRAINED BRAINS—A Striking Comparison in Power Production. By Lazarovich-Hrebelianovich. Reprint. 1919. (Gift of author.)
- MASTERS' ESSAYS. 1891-1917, 1918. Columbia University. (Gift of University.)
- MISSISSIPPI STATE GEOLOGICAL SURVEY, BULLETIN No. 14. A Revision with Additions of Bulletin No. 12. (Gift of Survey.)

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- MODERN INDUSTRIAL HOUSING.** By William E. Groben. 1918. (Gift of Ballinger & Perrot, Phila.)
- NATIONAL COAL ASSOCIATION.** Annual Meeting, 1919. Report and Suggestions of Committee on Standard System of Accounting and Analysis of Cost of Production.
- NEW ZEALAND OFFICIAL YEAR BOOK.** 1918. (Gift of Government of New Zealand.)
- ONTARIO BUREAU OF MINES, 1919.** Annual Report. Abitibi Night Hawk Gold Area. By C. W. Knight, A. G. Burrows, P. E. Hopkins and A. L. Parsons. Larder Lake Gold Area. By P. E. Hopkins. (Gift of Ontario Bureau of Mines.)
- PAN-AMERICAN COMMERCE.** Report of the Second Pan-American Commercial Conference. 1919.
- PLACER MINES OF CARIBO, BRITISH COLUMBIA, NOTES ON THE.** By J. B. Tyrrell 1919. Reprint. (Gift of author.)
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- REPORT OF AN INVESTIGATION OF THE AKRON INDUSTRIAL SALVAGE CO.** 1919. Waste Reclamation—Organization, Functions, and Objects of the National and Local Service. 1919. Dept. of Commerce, Waste-Reclamation Service, Washington, D. C. (Gift of Dept. of Commerce.)
- REPORT ON MINING OPERATIONS IN THE PROVINCE OF QUEBEC DURING YEAR 1918.**
- REPORT ON TRADE CONDITIONS IN BRITISH EAST AFRICA, UGANDA AND ZANZIBAR.** By T. Sleith. June, 1918. Union of South Africa. Department of Mines and Industries.
- REPORT OF THE VERMONT STATE GEOLOGIST.** 1917-1918.
- RESISTANCE TYPE ELECTRIC FURNACES FOR MELTING NON-FERROUS METALS.** By T. F. Bailey. 1919. (Gift of The Electric Furnace Co.)
- RURAL METHODS OF WASTE DISPOSAL.** By Henry D. Evans. Bulletin of the State Department of Health of Maine. 1919.
- SCIENCE AND INDUSTRY IN CANADA.** By Prof. John Cunningham McLennan. 1919. Reprint. London. (Gift of Canadian Mission in London.)
- SHIPBUILDING CHANNELS AND BULB SECTIONS.** 6th edit. By Carnegie Steel Company. (Gift of Company.)
- SPECIAL FIRE PREVENTION BULLETIN.** Publ. by National Association of the Motion Picture Industry, Inc. (Gift of Association.)
- STEAM TABLES FOR CONDENSER WORK.** Psychrometric Tables. 3d edit. (Gift of Wheeler Condenser & Engineering Co.)
- SUMMARY OF ATTEMPTED IMPROVEMENTS IN THE PUDDLING PROCESS.** By Cecil H. Desch. 1918. Glasgow. Reprint. (Gift of author.)
- TECHNISCHE ELEKTROCHEMIE.** By Dr. Paul Askenasy. Vol. II. Elektrolyse Wasseriger Lösungen und die Gewinnung des Aluminiums. 1916.
- TRANSPORTS SOUTERRAINS.** By F. Defize. 1914. (Gift of author.)
- TROISIÈME CONGRÈS INTERNATIONAL DU PÉTROLE.** Bucarest. Septembre, 1907.
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- VEREIN DEUTSCHER EISENHÜTTENLEUTE** (German Iron and Steel Institute) Report of the General Meeting, May, 1919. Translation by Sir Robt. Hadfield. (Gift of Sir Robt. Hadfield.)
- WAS THERE A "CORDILLERAN GLACIER" IN BRITISH COLUMBIA?** By J. B. Tyrrell. 1919. Reprint. (Gift of author.)

## Trade Catalogs

**ALLIS-CHALMERS MFG. Co., Milwaukee, Wisconsin.**

Centrifugal Pumps and Centrifugal Pumping Units.

Details of Allis-Chalmers Oil Engines—Diesel Type—For ordering repairs and spare parts.

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How to Apply the Transveyor to your Business.

**GENERAL ELECTRIC Co., Schenectady, N. Y.**

The Geco Resistor for Incandescent Headlights—500- to 600-volt Circuits. Rheostat and Compensator Operating Mechanisms. Bulletin No. 47702A. July, 1919. (3 copies.)

Electrically Heated Ovens. Bulletin No. 48021A. June, 1919.

Safety Panel Boards and Cabinets. Bulletin No. 47942. August, 1919.

**GREEN ENGINEERING Co., East Chicago, Ind.**

The Green Book of Progressive Combustion by Means of the Chain Grate Stoker. A Treatise on the Coals of the World—their Typical Analysis and Burning Characteristics.

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**TIDE WATER OIL Co., New York City.**

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Distribution Type Transformers. Bulletin 119.

**WESTINGHOUSE ELEC. & MFG. Co., East Pittsburgh, Pa.**

Westinghouse Electrification Data, June, 1915 to Feb., 1918.

Westinghouse Railway Engineering Data, June, 1919.

Type CA Carbon Circuit-breakers, Leaflet 3549-A.

1200-volt Direct-current Railway Equipments, Leaflet 3599-A.

Burke Steel Towers and Outdoor Substations, Leaflet 3502.

Westinghouse Underfeed Stoker at Republic Rubber, Leaflet 2044.

Type CS Control Switches, Leaflet 3499.

Baldwin-Westinghouse Mine Locomotive, Leaflets 1885 and 1887.

Westinghouse Geared Turbo-generator Units, Leaflet 3867-A.

Direct-current Commutating-pole Mill Motors, Leaflet 1101-B.

Small Motors and Their Uses, App. Circular 7300.

Electrical Precipitation, App. Circular 7375.

Protective Relays—Their Use on Alternating-current Systems.

Publication No. 1572-A.

Railway Converter Substations. By Chas. F. Lloyd. Circular 1563.

**WHEELER CONDENSER & ENGINEERING Co., Carteret, N. J.**

Wheeler-Balcke Cooling Towers. Bulletin 109-B.

## INDUSTRIAL SECTION

This department is devoted to material concerning the products or operations of manufacturers, which, in the estimation of the Editor, is of news value to the mining and metallurgical field, but does not come within the scope of the main editorial section of the Bulletin.

Manufacturers are invited to submit to the Editor items descriptive of new equipment or processes, large or significant installations, and similar material of news character. If found available, items thus furnished will be published in this section without charge, subject to such editorial revision and condensation as may be necessary.

In cases where illustrations are required, cuts of the proper size should accompany the text matter.

### MITCHELL ELECTRIC VIBRATING SCREEN

The Mitchell Electric Vibrating Screen is the invention of B. A. Mitchell, chief mechanical engineer of the Utah Copper Co. at Garfield, Utah, and is manufactured by the Stimpson Equipment Co., Felt Bldg., Salt Lake City, Utah. This screen, with a strong, persistent, upward, rotary movement, induced by electric power applied from beneath the screen, operates at the rate of 3600 vibrations per minute. Every wire and every mesh in the screen cloth describes a minute, circular path in the direction of the top of the screen with the result that every particle of material not immediately liberated is tossed back along its path across the screen cloth. The scope of this movement is very small, yet it is so continuous and so powerful that by the time a given load has traversed the screen cloth, practically every particle of the undersize has been segregated. In coarse crushing work each Mitchell screen is delivering a screened product of more than 1200 tons per 24 hr. of minus  $\frac{1}{2}$ -in. material. In fine crushing, dry work, it is delivering a screened product of more than 600 tons per 24 hr. of minus 10-mesh material. In fine crushing, wet work, it is delivering a screened product of more than 650 tons per 24 hr. of minus 10-mesh material.

### MCDUGALL ROASTING FURNACES

The McDougall roasting furnace, made by the Allis-Chalmers Mfg. Co., is a mechanically operated, circular multiple-hearth furnace of the self-contained type, having two or more hearths superimposed upon each other. It consists of a cylindrical steel-plate shell that contains and supports the various hearths, shafts, rakes, feeder, etc. This shell, together with the cast-iron plates that form the bottom of the furnace, are, in the standard type of furnace, supported 10 or 12 ft. above the ground level by structural steel beams and columns; the latter also carry the driving machinery. The shell of this furnace, when used on self-roasting ores, has a brick lining 9 in. thick, from which are sprung, at intervals of about 3 ft., flat arches that form the various hearths of the furnace. These arches are also 9 in. thick, the entire brickwork for one of the furnaces being built from common red brick.

When it is necessary to recover the sulfurous acid for acid making, these furnaces are furnished with one or more muffled hearths; they are also built for this purpose, by diverting the coal gases from the lower hearths, the percentage of sulfur in the ore being sufficient to maintain a vigorous combustion in the upper hearths, the ore passing through a normally sealed opening into this lower hearth. This is a much more efficient furnace than the muffled type, but necessitates the wasting of the small amount of sulfur dioxide set free in the lower hearth.

These furnaces are used in Montana and Utah on sulfide ores carrying approximately 35 per cent. of sulfur, the calcines discharged from the furnace containing from 7 to 9 per cent. It is possible to give almost any desired amount of grate area to a furnace, so that, if necessary, material can be brought to a dead roast and subjected to temperatures up to 2000° F., or more.

### CENTRIFUGAL PUMPS AND PUMPING UNITS

A centrifugal pump has certain fixed characteristics, which are determined when the pump is designed and which the purchaser cannot readily alter by adjustment. Likewise, the motor, turbine or other driving agent has exact characteristics that must be adapted to the pump. Many centrifugal pumps, perhaps the majority of them, are driven by electric motors, consequently the operating cost is definitely known. This makes the question of efficiency of paramount importance. The Allis-Chalmers Co. now builds standard types of centrifugal pumps in the smaller sizes which have the same reputation as its large machinery. These standard pumps have been developed to meet all pumping requirements such as city water supply, sewage pumping, service in filtration plants, underwriters' fire pumps, condenser pumps, paper-mill stock pumps and pumps for a variety of uses in industrial plants, packing houses, etc.

### THE NORDSTROM LUBRICATED PLUG VALVE

The function of a plug valve in any pipe line is to permit or interrupt the flow of the fluid conveyed by the pipe line. An ordinary well-built plug valve will not stick nor leak as long as the bearing surfaces are properly lubricated. The constant film of lubricant between the bearing surfaces of the Nordstrom plug valve, sold by The Merrill Co., 121 Second St., San Francisco, Calif., effectually prevents the entrance of any foreign substance and wear and corrosion are therefore reduced to a minimum. This valve will remain tight even under the most severe conditions, as for instance, in an ore-treatment plant handling a sandy slime pulp under pressures of from 40 to 50 lbs. An ordinary plug valve cuts out and begins to leak in a few weeks under such conditions. Nordstrom Plug Valves have been in continuous use in several plants in Mexico for over 3 yrs. and still show no signs of material wear. Nordstrom Lubricated Plug Valves, all iron, for working pressures up to 125 lbs. per sq. in. are made for screwed connections in all the usual pipe sizes from 1 to 6 in., inclusive, and for flanged connections from 2 to 8 in., inclusive.

### NEW GOVERNMENT PUBLICATIONS

Publications should be ordered by number and title; applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

BULLETIN 168. Recovery of zinc from low-grade and complex ores, by D. A. Lyon and O. C. Ralston. 1919. 145 pp., 23 figs.

BULLETIN, 178-B. War minerals, nitrogen fixation, and production of sodium cyanide, by Van. H. Manning. 1919. 61 pp.

BULLETIN 178-C. Petroleum investigations and production of helium, by Van. H. Manning. 1919. 87 pp.

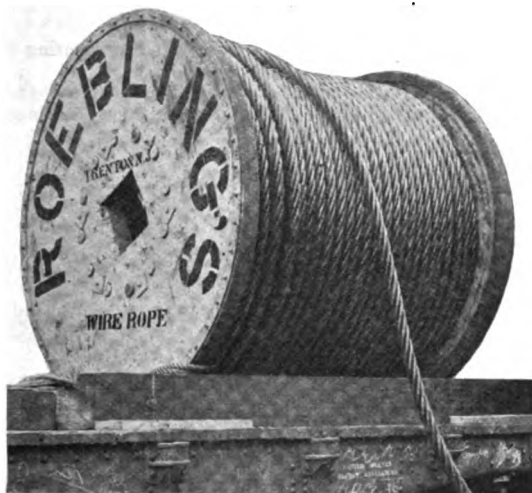
BULLETIN 178-D. Explosives and miscellaneous investigations, by Van. H. Manning. 1919. 23 pp.

TECHNICAL PAPER 220. Burning steam sizes of anthracite with or without admixture of soft coal, by U. S. Fuel Administration. 1919. 8 pp

TECHNICAL PAPER 222. Method of administering leases of iron-ore deposits belonging to the State of Minnesota, by J. R. Finlay. 1919. 40 pp., 1 fig.

TECHNICAL PAPER 225. The vapor pressure of lead chloride, by E. D. Eastman and L. H. Duschak. 1919. 16 pp., 2 pls., 2 figs.

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# THE MINING AND METALLURGICAL INDEX

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## MINERAL RESOURCES EXCLUSIVE OF COAL AND OIL

### GENERAL

- ALBERTA, Mineral resources of. *Bull. Canad. Min. Inst.* (Sept., 1919) 964-7. 700 w.
- BELGIUM, Mining and metallurgical industries in. C. R. Nasmyth, *Commerce Repts.* (Aug. 29, 1919) 1108-12. 1500 w. Abstract of report by Minister of Industry.
- CANADA, Industrial minerals of. Les minéraux industriels du Canada. W. Malcolm. *Métal. Alliage & Mach.* (July-Aug., 1919) 8-10. 1500 w. Serial.
- CLINTON District, B. C., Undeveloped mineral resources of the. L. Reinecke, *Bull. Canad. Min. Inst.* (Sept., 1919) 940-50. Serial.
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- INDIANA, Raw material resources of. W. N. Logan, *Chem. & Met. Engng.* (Sept. 15, 1919) 21, 320-3. 2000 w.
- IRON, coal and ochre deposits, Pittsworth District, Queensland. J. H. Reid. *Queensland Govt. Min. Jnl.* (July 15, 1919) 20, 284-5. 1500 w. Survey report.
- LASALLE district, Mineral resources of the. J. A. Ede, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2609-30.
- MICHIGAN, Mineral resources of. R. A. Smith, *Chem. & Met. Engng.* (Sept. 15, 1919) 21, 326-30. 3500 w.
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- MINERAL SUPPLIES, Our. Bibliography compiled under direction of G. M. Wood. U. S. Geol. Surv. *Bull.* 666-CG. 58 pp. Considers only publications issued by the U. S. Geol. Surv. of minerals listed.
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- MAGNETITE, Magnetic properties of varieties of. E. Wilson and E. F. Herroun, *Proc. Physical Soc. of London* (Aug. 15, 1919) 31, 299-318.
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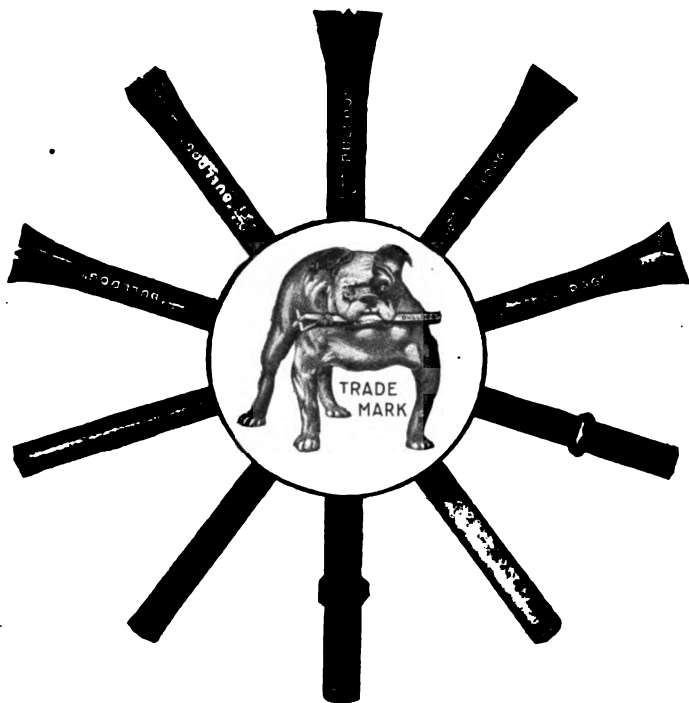
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- CHROME-ORE deposits in Cuba. E. F. Burchard, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2523-46.
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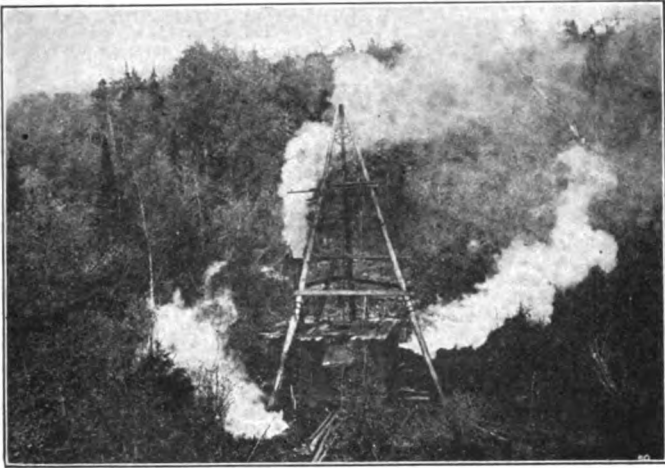
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- GOLD AREA, Abitibi-Night Hawk.** C. W. Knight, A. G. Burrows, P. E. Hopkins and A. L. Parsons, Ontario Bur. of Mines (1919) 28, 1-70.
- GOLD AREA, Larder Lake.** P. E. Hopkins, Ontario Bur. of Mines (1919) 28, 71-7. 2500 w.
- MANGANESE in the Transvaal.** *So. Afr. Min. Jnl.* (July 5, 1919) 28, 527-30. 3500 w. Describes ore deposit and geological conditions.
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- MERCURY deposits in British Columbia.** C. Cammell, *Canad. Chem. Jnl.* (Sept., 1919) 3, 307-8. 1500 w.
- PYRITES and sulphur industry, Information concerning the.** U. S. Tariff Com. (June 14, 1919) 7-31.
- QUEBEC during the year 1918, Report on mining operations in the Province of.** Quebec Bur. Mines (1919) 7-156. Review and statistical tables.
- SILESIA, Cobalt and nickel ores in.** Die friderizianischen Kobalt und Nickelerse der Kupferberger Erzbergwerke bei Kupferberg i. Schl. B. Kosmann, *Metall. u. Ers.* (Mar. 22, 1919) 115-23. 5000 w.
- TIN economics and world markets.** *Raw Material* (Aug., 1919) 1, 282-9. 4800 w. Compendium of international tin situation. Smelting, grades, analyses, uses, etc.
- TIN FIELD, Kangaroo Hills.** E. J. Laun, *Queensland Govt. Min. Jnl.* (July 15, 1919) 20, 319-20. 700 w. Inspector's report for June.
- TUNGSTEN-BEARING ores, Information concerning.** U. S. Tariff Com. (June 14, 1919) 9-47.
- TUNGSTEN metals in Australia.** Col. Abbott, *Indust. Austral.* (July 31, 1919) 82, 199-200. 2500 w.
- WASAPIKA gold area, Recent developments in.** R. E. Hore, *Canad. Min. Jnl.* (Sept. 10, 1919) 40, 677-8. 1000 w.
- ZINC CORPORATION, Development of the Collinsville (Ill.) Engng. & Min. Jnl.** (Sept. 13, 1919) 108, 461-2. 800 w.
- ZINC DISTRICT, Wisconsin.** W. F. Boericke and T. H. Garnett, *Bull. A. I. M. E.* (Aug., 1919) 1213-35.
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- NON-METALLIC MINERALS**
- FULLER'S earth in 1918.** J. Middleton, with bibliography. U. S. Geol. Surv. *Mineral Resources of the U. S.*, 1918, pt. 2 (Aug. 27, 1919) 135-40. 3000 w.
- GEMS and precious stones in 1918.** W. T. Schaller, U. S. Geol. Surv., *Mineral Resources of U. S.*, 1918, pt. 2 (July 16, 1919) 7-14.
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- GRAPHITE in Chile.** El grafito de Chile. *Bol. Soc. Fomento Fabril* (June, 1919) 361-2. 500 w.
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- LIME in ore dressing and metallurgy, Uses of.** P. T. Bruhl, *Rock Products* (Aug. 16, 1919) 22, 33-5. 3000 w.
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- MAGNESITE: Its geology, products, and their uses.** C. D. Dolman, *Bull. A. I. M. E.* (Aug., 1919) 1193-1202. 3500 w.
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- MARBLES of the United States, Physical and chemical tests on the commercial.** D. W. Kessler, U. S. Bur. Standards, *Tech. Paper* 123 (July 15, 1919) 3-53.
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- BREATHING apparatus, Development and improvement of.** H. H. Sanderson, *Sci. & Art of Min.* (Aug. 23, 1919) 20, 18-9. 2000 w. From *Canad. Min. Inst. Bull.*
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- COPPER sulphides in syenite and pegmatite dikes. D. H. McLaughlin, *Econ. Geol.* (Aug., 1919) 14, 403-10. 2500 w.
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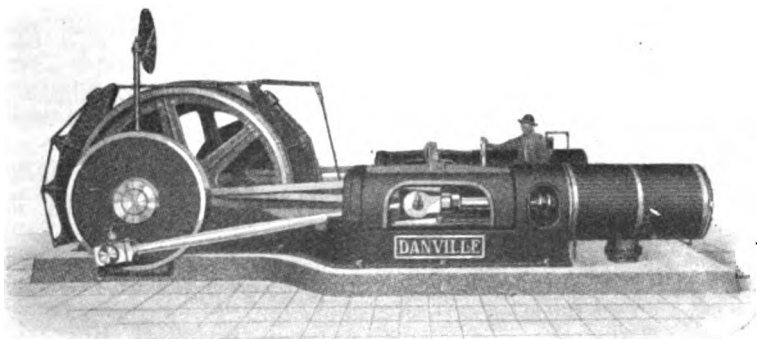
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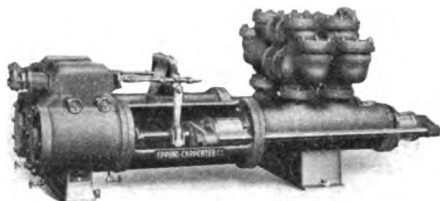
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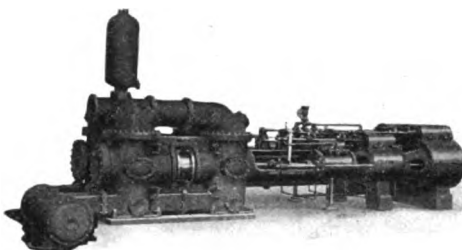
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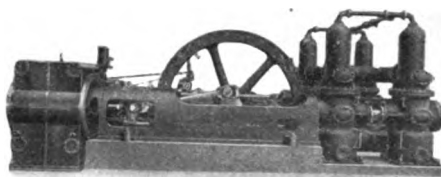
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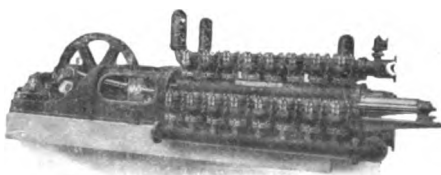
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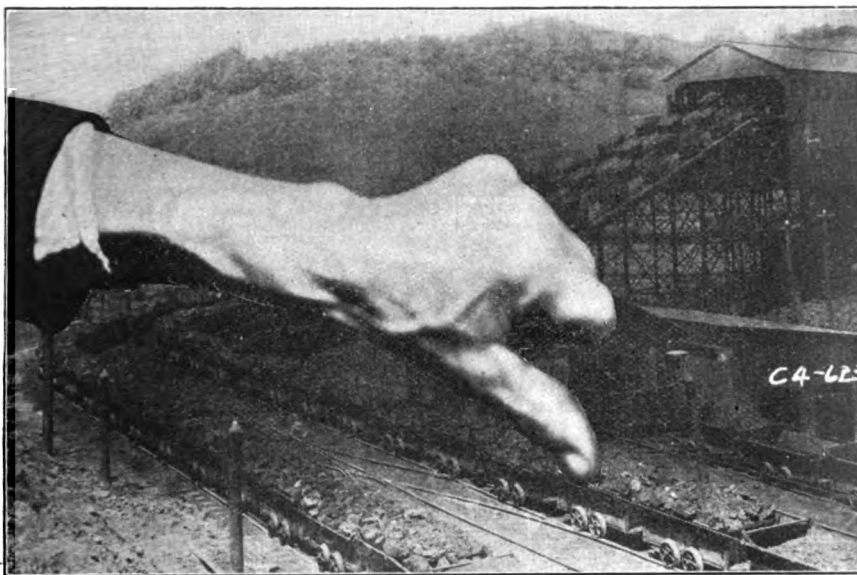
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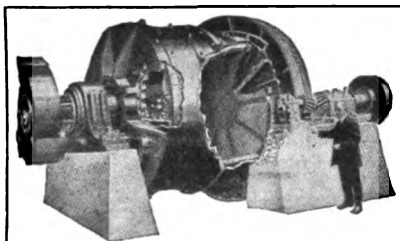


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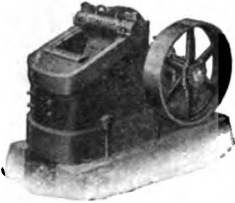
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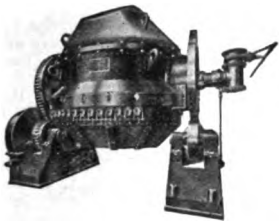
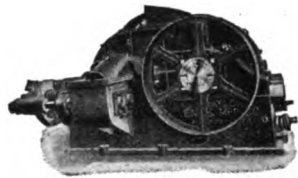
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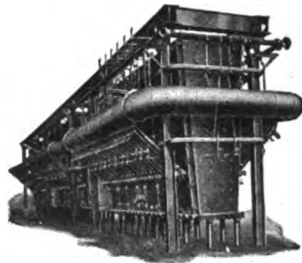
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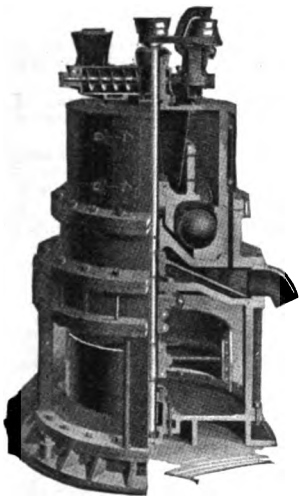
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- MANGANIN**, Manufacture and electrical properties of. F. E. Baah, *Bull. A. I. M. E.* (Sept., 1919) 1717-22. 2000 w. Alloy composed chiefly of copper and manganese.
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- PORCELAIN** for pyrometric purposes. F. H. Riddle, *Bull. A. I. M. E.* (Sept., 1919) 2207-17. 3500 w.
- PYROMETER**, L. Forester, U. S. Pat. 1315716. *Off. Gas.* (Sept. 9, 1919) 266, 235. 150 w.
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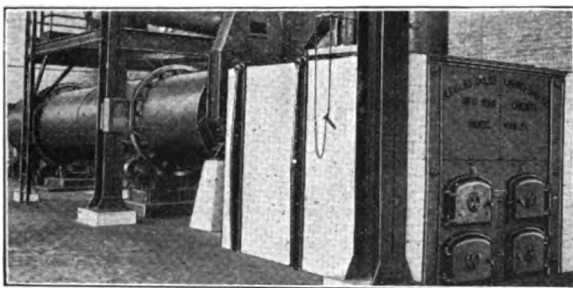
- PYROMETER** protection tubes. O. Hutchins, *Bull. A. I. M. E.* (Sept., 1919) 1811-6. 1200 w.
- PYROMETER**, Self-checking galvanometer. H. F. Porter, *Bull. A. I. M. E.* (Sept., 1919) 1803-6. 1800 w.
- PYROMETER** shortcomings in glass-house practice. W. M. Clark and C. D. Spencer, *Bull. A. I. M. E.* (Aug., 1919) 1455-8. 1500 w.
- PYROMETER** standardisation, Metals for. C. W. Waidner and G. K. Burgess, *Bull. A. I. M. E.* (Aug., 1919) 1511-2. 700 w.
- PYROMETERS**, Automatic compensation for cold-junction temperatures of thermocouple. F. Wunsch, *Bull. A. I. M. E.* (Sept., 1919) 2065-71. 1800 w.
- PYROMETERS**, Recording thermocouple. L. Behr, *Bull. A. I. M. E.* (Sept., 1919) 1655-60. 1800 w.
- PYROMETERS** to ceramic industry, Application of. J. P. Goheen, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2255-64. 3000 w.
- PYROMETRY** applied to bottle-glass manufacture. R. L. Frink, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2233-40. 3000 w.
- PYROMETRY** as applied to manufacture of optical glass. C. W. Keuffel, *Bull. A. I. M. E.* (8 pt., 1919) 2151-3. 600 w.
- PYROMETRY**, Fundamental laws of. C. E. Mendenhall, *Bull. A. I. M. E.* (Sept., 1919) 2125-33. 3500 w.
- PYROMETRY** in the manufacture of optical glass. A. J. Walcott, *Bull. A. I. M. E.* (Sept., 1919) 1851-4. 1500 w.
- PYROMETRY** in rotary Portland cement kilns. L. I. Dana and C. O. Fairchild, *Bull. A. I. M. E.* (Sept., 1919) 1661-73.
- PYROMETRY** in the manufacture of clay wares. F. K. Pence, *Bull. A. I. M. E.* (Sept., 1919) 2107-9. 900 w.
- PYROMETRY**, Optical and radiation. P. D. Foote and C. O. Fairchild, *Bull. A. I. M. E.* (Aug., 1919) 1388-1415.
- PYROMETRY**, Recent developments in. R. P. Brown, *Bull. A. I. M. E.* (Sept., 1919) 1979-94.
- PYROMETRY**, Recording. C. O. Fairchild and P. D. Foote, *Bull. A. I. M. E.* (Sept., 1919) 1627-54.
- PYROMETRY**, Teaching. O. L. Kowalko, *Bull. A. I. M. E.* (Aug., 1919) 1425-7. 1300 w.
- PYROMETRY** in technical schools, Teaching. C. E. Mendenhall, *Bull. A. I. M. E.* (Sept., 1919) 2143-6. 1200 w.
- PYROMETRY** in our technical schools, Teaching. G. V. Wendell, *Bull. A. I. M. E.* (Sept., 1919) 2097-2106. 4200 w.
- PYROMETRY**, Thermoelectric. P. D. Foote, T. R. Harrison and C. O. Fairchild, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2631-86.
- PYROMETRY** to problems of lamp design and performance, Application of. J. H. Van Horn, *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2247-53. 1200 w.
- PYROMETRY** to the ceramic industries, Application of. C. B. Thwing, *Bull. A. I. M. E.* (Sept., 1919) 2139-42. 1500 w.
- PYROMETRY** to the manufacture of gas-mask carbon, Application of. K. Marsh, *Bull. A. I. M. E.* (Sept., 1919) 1611-26.
- RADIOMETALLOGRAPHY**. R. Hadfield, *Jnl. Am. Steel Treat. Soc.* (May, 1919) 1, 256-69. Remarks at the discussion of Faraday Soc. and Röntgen Soc., Apr. 29, 1919.
- ROLLING** metals. E. W. Davies, *British Pat.* 128767. *Ill. Off. Jnl.* (Aug. 27, 1919) 2597. 175 w.
- SILVER** refining operations, Application of the Cottrell processes to the recovery of fume from. W. G. Smith and A. A. Heimrod, *Chem. & Met. Engrg.* (Sept. 15, 1919) 21, 360-3. 2500 w.
- THERMOCOUPLES** and base-metal thermoelectric practice, Alloys suitable for. J. M. Lohr, *Bull. A. I. M. E.* (Sept., 1919) 1837-43. 2500 w.
- THERMOCOUPLES**, Protecting tubes for. R. B. Lincoln, *Bull. A. I. M. E.* (Sept., 1919) 2147-50. 1500 w.
- THERMOCOUPLES**, Reference standard for base-metal. N. E. Bonn, *Bull. A. I. M. E.* (Sept., 1919) 2135-7. 800 w.
- THERMOCOUPLES**, Tables and curves for use in measuring temperatures with. L. H. Adams, *Bull. A. I. M. E.* (Sept., 1919) 2111-24.
- THERMOMETRY**, Resistance. F. W. Robinson, *Bull. A. I. M. E.* (Sept., 1919) 1829-36. 2500 w.
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- TIN**: An ideal pyrometric substance. E. F. Northrup, *Bull. A. I. M. E.* (Aug., 1919) 1443-4. 800 w.
- TIN** dressing floors in Cornwall, Note on certain effluent waters from. J. C. Philip, *Bull. 179, Inst. of Min. & Met.* (Aug. 21, 1919) 1-2. 500 w.
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- TIN** industries. Les industries de l'étain. *Métaux, Alliages & Mach.* (July, Aug., 1919) 4-7. 2500 w.
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- WORK** on metals and alloys, Effect of. O. W. Ellis, *Engrg.* (Aug. 29, 1919) 108, 290-2. 4000 w. Read before Inst. of Metals, Mar. 26, 1919.
- WULFENITE**, Notes on the metallurgy of. J. P. Bonardi, *Chem. & Met. Engrg.* (Sept. 15, 1919) 21, 364-9. 5000 w.
- ZINC** dust. A peculiar form of. Über eine eigenartige form des sinkstaubs. O. Mühlbauer, *Metall. u. Erz.* (Feb. 22, 1919) 70, 500 w.
- ZINC**-RETORT residues, Treatment of. O. Spitzer and C. C. Conover, U. S. Pat. 1315349. *Off. Gaz.* (Sept. 9, 1919) 266, 170. 50 w.
- ZINC** to have place as building material. Sheet. G. P. Stone, *Metal Worker* (Aug. 29, 1919) 92, 245-7. 2500 w. Used for roofing and other purposes.

## FIRE

- ALLOYING**, Admixture of metals or substances for. E. G. Burr, U. S. Pat. 1315208. *Off. Gaz.* (Sept. 9, 1919) 266, 144-5. 80 w.
- ALLOYING**, Selected chapters from the art of. Ausgewählte Kapitel aus der legierungskunde. E. H. Schults, *Metall.* (May 10, 1919) 118-20. 1600 w.
- ALLOYS** of high zinc content, Copper-aluminum-zinc. Studie über die hochzinkhaltigen Kupfer-Aluminium-Zink-Legierungen. E. H. Schults and M. Waehlert, *Metall. u. Erz.* (Apr. 22, 1919) 16, 170-6. 2500 w.

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- ALLOYS**, Pouring of lead, tin, and white metal. Vergießen von blei, zinn, und weissmetalllegierungen. *Métall. u. Erz.* (Feb. 22, 1919) 70-4. 2000 w.
- ALUMINIUM** alloy castings. Heat treatment of. Z. Jeffries and W. A. Gibson. *Bull. A. I. M. E.* (Sept., 1919) 2493-2512.
- ALUMINIUM** alloys. Some. Quelques alliages divers d'aluminium. J. Escard. *Métall., Alliages & Mach.* (July-Aug., 1919) 1-4. 2000 w.
- ALUMINIUM** alloys. Studies in. Studien über technische aluminiumlegierungen. E. H. Schuls. *Métall. u. Erz.* (Mar. 8, 1919) 18, 91-101. 3000 w.
- ALUMINIUM** ingot. Metallography of. R. J. Anderson. *Chem. & Met. Engng.* (Sept. 1, 1919) 21, 229-34. 2500 w.
- ALUMINIUM**, its alloys and their strength. Betrachtungen über Aluminium, Aluminiumlegierungen und deren Festigkeiten. H. Rieger. *Giessereizeit.* (May 15, 1919) 151-3. 1500 w.
- ANNEALING**. Outline prepared for topical discussion on. *Jnl. Am. Steel Treat. Soc.* (May, 1919) 1, 270-8. 4500 w.
- ANNEALING** and heat treatment of non-ferrous metals. F. J. Bralce, with discussion. *Trans. Liverpool Engng. Soc.* (1918) 29, 183-212.
- ANNEALING** of glass. A. Q. Tool and J. Valasek. *Bull. A. I. M. E.* (Sept., 1919) 1945-52. 3000 w.
- BRASS**, Electric rotating furnace for. C. H. Booth. *Metal Ind.* (July 25, 1919) 18, 63-5. 3800 w. Read before Am. Inst. Chem. Engrs.
- BRONZE** casting. La fonderie de bronze. A. Legrand. *Fonderie Moderne* (March, 1919) 92-5. 2000 w.
- ASTING** bronze under pressure. *Metal Ind.* (Aug. 15, 1919) 18, 130. 700 w.
- CASTING-MACHINE**. E. H. Acton, F. E. Dickie, and T. Pratt. U. S. Pat. 1316471. *Off. Gas.* (Sept. 16, 1919) 266, 391. 60 w.
- CASTINGS** at Cramp's. Making alloy. *Foundry* (Sept. 15, 1919) 47, 641-6. 2000 w.
- CASTINGS** from bronze and other copper alloys. New process of making. Nachrichten über neue verfahren zur herstellung von gussstücken aus bronze und anderen kupferlegierungen in permanenten metallsormen. *Metall-Technik* (Apr. 19, 1919) 58. 500 w.
- CASTINGS**, Notes on permanent molds and centrifugal. J. E. Hurst, with discussion. *Fdy. Tr. Jnl.* (Aug., 1919) 21, 558-63. 4500 w.
- CORE** and mold for metal castings and method of making the same. J. T. Fahy, U. S. Pat. 1315293. *Off. Gas.* (Sept. 9, 1919) 266, 160. 20 w.
- DIE-CASTING**. Modern developments in. A. Bregman. *Metal Ind.* (Aug. 29, 1919) 18, 163-4. 1000 w.
- FUSING** sulfur from low-grade ores. Apparatus for. P. P. Austin, Jr., U. S. Pat. 1315940. *Off. Gas.* (Sept. 16, 1919) 266, 291. 65 w.
- HEAT** treatment on gun metal. Influence of. C. F. Smart. *Bull. A. I. M. E.* (Sept., 1919) 1875-81. 1200 w.
- HEATING** moulds for metal. Method of. A. C. Atkinson. *Canad. Pat.* 192390. *Off. Rec.* (Sept. 2, 1919) 47, 1461. 200 w.
- HIGH** temperature scale and its application in the measurement of true brightness, and color temperatures. E. P. Hyde. *Bull. A. I. M. E.* (Sept., 1919) 1969-74. 2200 w.
- MAKING** flanged articles; casting metals. E. C. R. Marks. *British Pat.* 128708. *Ill. Off. Jnl.* (Aug. 27, 1919) 2578-9. 200 w.
- METAL** casting process. Alpha Products Co., Inc. *Canad. Pat.* 192346. *Off. Rec.* (Aug. 26, 1919) 47, 1436. 300 w.
- MELTING** metals. Art of. W. H. Bristol. U. S. Pat. 1315206. *Off. Gas.* (Sept. 9, 1919) 266, 144. 24 w. Preventing oxidation.
- MOULDING** metals. *British Pat.* 128389. *Ill. Off. Jnl.* (Aug. 13, 1919) 2464. 110 w.
- NON-BLACK** bodies. Emissive powers and temperatures of. A. G. Worthing. *Bull. A. I. M. E.* (Sept., 1919) 1895-1927.
- PLATE** problem. G. C. Swift, with discussion. *Fdy. Tr. Jnl.* (July, 1919) 21, 463-70. 7500 w. Composition of the alloy, methods etc.
- QUICKSILVER** from its ore. Process of recovering. H. W. Gould. U. S. Pat. 1315663. *Off. Gas.* (Sept. 9, 1919) 266, 225. 55 w.
- RADIATION** constants. Present status of. W. W. Coblenz. *Bull. A. I. M. E.* (Aug., 1919) 1283-4. 700 w.
- ROASTING** ores, furnace products, ore mixtures and the like. Process of. E. B. Kirby. U. S. Pat. 1316726. *Off. Gas.* (Sept. 23, 1919) 266, 488. 85 w.
- SMELTERY**. New South Wales lead. *Engng. & Min. Jnl.* (Sept. 6, 1919) 108, 394-5. 1500 w. Cockle Creek silverlead works.
- SMELTING** plant. Cockle Creek. G. Courtney. *Min. & Sci. Pr.* (Aug. 30, 1919) 119, 303-4. 1200 w.
- SULFUR** from ore. Process of extracting. J. Coffeen. U. S. Pat. 1314856. *Off. Gas.* (Sept. 2, 1919) 266, 71. 40 w.
- TEMPERATURE**. Standard scale of. C. W. Waidner, E. F. Mueller, and P. D. Foote. *Bull. A. I. M. E.* (Sept., 1919) 2051-63.
- TEMPERATURES** of incandescent lamp filaments. B. E. Shackelford. *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2265-9. 1100 w.
- TREATING** copper ores by sulfatization and flotation. Process of. N. C. Christensen. U. S. Pat. 1316352. *Off. Gas.* (Sept. 16, 1919) 266, 368. 45 w.
- TREATING** ores and concentrates. Process for. M. F. Coolbaugh. U. S. Pat. 1315761. *Off. Gas.* (Sept. 9, 1919) 266, 243. 35 w.
- ZINC** bronzes. Five foundry tests of. C. P. Karr. *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2485-92. 1500 w.
- ZINC** plants. Gas-producer practice at western. G. B. Brooks and C. C. Nitchie. *Bull. A. I. M. E.* (Sup.) (Sept., 1919) 2721-73.

## HYDRO

- ACTIVATED** sludge process. "Aktiveret Slam" til Renning af Kloakvand. G. P. Harvey. *Teknisk Tidsskrift* (July 23, 1919) 101-8. 4000 w.
- ELECTRODEPOSITION** of gold and silver from cyanide solutions. S. B. Christy. U. S. Bur. of Mines. *Bull.* 150 (1919) 7-162.
- LEACHING** process. Chemical and electrochemical problems involved in New Cornelia Copper Co.'s. H. S. Mackay. *Bull. A. I. M. E.* (Sept., 1919) 1929-44.
- LIXIVIATION**. Continuous. Kontinuierliches Laugen im Gegenstrom. H. Bäcker-de Florin. *Métall. u. Erz.* (Apr. 8, 1919) 18, 141-7. 3000 w.
- TREATING** copper ores by lixiviation with an  $\text{SO}_2$  solution. Process of. N. C. Christensen. U. S. Pat. 1316351. *Off. Gas.* (Sept. 16, 1919) 266, 368. 60 w.



# Results

The following data are from a well known cyanide plant and covers cost of agitation in three 40' X 25' Dorr Agitators. Labor for operation has not been included as it requires but a small part of one man's time to attend to six machines.

## AGITATION COST PER TON OF ORE AGITATED FOR 24 HOURS

|                         |        |
|-------------------------|--------|
| Electric Power.....     | 0.0015 |
| Air.....                | 0.0028 |
| Operating Supplies..... | 0.0001 |
| Repairs Supplies.....   | 0.0003 |
| Repairs Labor.....      | 0.0004 |

**TOTAL COST PER TON PER 24 HRS. = \$0.0051**

### SCREEN TEST (Cumulative)

|           |       |
|-----------|-------|
| + 35..... | 4.90  |
| + 48..... | 13.70 |
| + 65..... | 23.80 |
| +100..... | 35.80 |
| +150..... | 44.76 |
| +200..... | 53.72 |
| -200..... | 46.28 |

NOTE.—Dilution Solution to Ore ..... 1.2:1

Sp. Gr. Dry Ore..... 2.7

Sp. Gr. Pulp..... 1.5

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## ELECTRO

- BRASS**, Electric rotating furnace for. C. H. Booth, *Metal Ind.* (July 25, 1919) 16, 63-5. 3000 w. Read before Am. Inst. Chem. Engrs.
- BRASS-MAKING** induction furnaces, Operating. R. N. Blakelee, Jr. *Elect. Wld.* (Sept. 20, 1919) 74, 642-4. 2000 w.
- CARBON-FREE** alloys, Electric production of. E. F. Northrup, *Chem. & Met. Engrg.* (Sept. 1, 1919) 21, 258-9. 700 w.
- ELECTRIC** brass melting—Its progress and present importance. H. M. St. John, *Elect. Jnl.* (Sept., 1919) 16, 373-80. 7800 w.
- ELECTRIC** furnace. F. Rowlinson, *Sci. Am. Sup. I.* (Aug. 30, 1919) 88, 132-3. 3000 w. Serial. Its development, scope, and future. II. (Sept. 20, 1919) 88, 180-1, 191. 3500 w. Serial concluded.
- ELECTRIC** furnace developments for metals. *Metal Ind.* (Sept., 1919) 17, 424-7. 2500 w.
- ELECTRIC** furnace, A square deal for the. H. G. Weidenthal, Am. Electrochem. Soc. *Advance Copy* (Sept. 26, 1919) 95-100. 2000 w.
- ELECTRIC** furnaces. *Power Plant Engrg.* (Sept. 1, 1919) 28, 781-4. 1800 w. Abstract of committee report to N. E. L. A. Types of smelting and refining furnaces.
- ELECTRIC** furnaces, Commercial testing of metallurgical. H. M. St. John, *Chem. & Met. Engrg.* (Sept. 15, 1919) 21, 377-92.
- ELECTRIC** furnace in the tin industry, Oscillating. Le four oscillant électrique dans l'industrie du laitron. E. Dieudonne, *Métaux, Alliages & Mach.* (July-Aug., 1919) 10-1. 1500 w.
- ELECTRIC** furnaces for soaking, annealing and heat treating, Bailly. *Metal Tr.* (Sept., 1919) 10, 411-3. 1500 w.
- ELECTRIC** furnaces, Design of. R. C. Goarow, *Chem. & Met. Engrg.* (Sept. 1, 1919) 21, 235-41. 6500 w. Special reference to ferromanganese.
- ELECTRIC** furnaces, Manufacture of ferro-alloys in. C. B. Gibson, *Elect. Jnl.* (Sept., 1919) 16, 366-72. 5500 w.
- ELECTRODEPOSITED** metals, Factors governing the structure of. W. Blum, Am. Electrochem. Soc. *Advance Copy* (Sept. 26, 1919) 57-76.
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- SPITZBERGEN**, Swedish coal mining in. Der Schwedische kohlenbergbau in Spitzbergen. *Bergbau* (June 5, 1919) 463. 1000 w.
- STEEL**. P. MacGregor and A. Balfour, British Pat. 129330. *Ill. Off. Jnl.* (Sept. 10, 1919) 2801. 70 w. Steel suitable for cutting tools.
- STEEL** manufacture. H. C. Ryding and A. W. Allen, British Pat. 128836. *Ill. Off. Jnl.* (Aug. 27, 1919) 2621. 130 w. Basic open-hearth steel made from blown metal and slag forming material.
- SYDVARANGER** iron ore mines and works. *Iron & Coal Tr. Rev.* (Aug. 22, 1919) **99**, 229-30. 1200 w.
- TUNGSTEN** before, during and after the war. Le tungstene avant, pendant, et après la guerre. L. Campredon, *Métallurgie* (Sept. 3, 1919) 2369-70. 900 w.
- WINDING** drum at a Belgian colliery. Biconical. A. Bertiaux, *Coll. Guard.* (Aug. 22, 1919) **118**, 490. 1600 w. From *Ann. des Mines de Belgique*.

### SOUTH AMERICA AND MEXICO

- CAST** pipe in South America. Centrifugally. *Iron Age* (Sept. 23, 1919) **104**, 963-5. 700 w. De Lavaud process in Brazil and Argentine.
- "El Teniente," Work and life at. El Trabajo i la Vida en el Mineral "El Teniente." A. F. Grandon, *Bol. Soc. Nacional de Minería* (Apr., 1919) **31**, 271-350. Serial.
- GRAPHITE** in Chile. El grafito de Chile. *Bol. Soc. Fomento Fabril* (June, 1919) 361-2. 500 w.
- GUATAMALA**, Mineral resources of. *Jnl. Roy. Soc. Arts* (Aug. 22, 1919) **67**, 632-3. 900 w.
- MEXICO** and petroleum exploitation. J. Santalillo, *Petr. Times* (Aug. 30, 1919) **3**, 197-200. 202. 4500 w. Official statement.
- MINING** at Braden. F. Cameron, *Min. & Sci. Pr.* (Sept. 20, 1919) **119**, 405-12. 2500 w. Method of shrinkage stoping.
- PETROLEUM** in state of Tamaulipas. G. Biardone, *Oil & Gas Jnl.* (Sept. 26, 1919) **18**, 58-60. 2200 w.
- PILARES** mine, Geology and mining methods at. W. R. Wade and A. Wandtke, *Bull. A. I. M. E.* (Aug., 1919) 1143-69.

## Back Volumes at Reduced Prices

**O**WING to the big sale of Back Volumes of the Transactions since the price-list was issued, our stock has been so reduced that it is necessary to increase the price.

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# CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Acids and Ammonia**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Acid, Sulphuric**

Illinois Zinc Co., Peru, Ill.

**Agitators**

Dorr Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.

**Air Compressors, Motors, etc. (See Compressors, Motors, etc., Air)****Amalgamators**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp., 115 Broadway, New York City.

**Assay Supplies**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway New York City.

**Atlas Mine Car**

Fuller-Lehigh Co., Fullerton, Pa.

**Balances and Weights**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.

**Ball and Tube Mill Parts (Kominuter Parts)**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights, Ill.

**Bearings, Ball**

William Co., 253 W. 58th St., New York City.

**Bearings, Roller**

William Co., 253 W. 58th St., New York City.  
Hyatt Roller Bearing Co., Metropolitan Tower, New York City.

**Belting, Conveyor**

Goodrich Rubber Co., B. F., Akron, O.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.

**Belting, Elevator**

Goodrich Rubber Co., B. F., Akron, O.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Belting, Transmission**

Goodrich Rubber Co., B. F., Akron, O.

**Bins, Coal and Coke**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Blasting Powder (See Powder, Blasting)****Blasting Supplies**

Atlas Powder Co., Wilmington, Del.  
Du Pont de Nemours & Co., F. I., Wilmington, Del.  
Hercules Powder Co., Wilmington, Del.

**Blowers**

General Electric Co., Schenectady, N. Y.

**Blowing Engines (See Engines, Blowing)****Blowpipe Apparatus**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Brick, Fire**

Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.

**Buckets, Elevator**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Burners, Oil**

Mine and Smelter Supply Co., 42 Broadway, New York City.

**Cableways**

Flory Mfg. Co., S., Bangor, Pa.  
Leschen & Sons Rope Co., A., 920 N. 1st St., St. Louis, Mo.  
Macomber & Whyte Rope Co., Kenosha, Wis.  
Roebbling's Sons Co., John A., Trenton, N. J.

**Cages, Hoisting**

Chalmers & Williams, Inc., Chicago Heights, Ill.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.

**Cages, Self Dumping and Plain**

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Car Lifts, Automatic**

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Carbide Lamps**

Macleod Co., Bogen St., Cincinnati, Ohio.

**Cars, Ore**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.

**Castings, Brass**

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Castings, Iron**

Fuller-Lehigh Co., Fullerton, Pa.  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Caustic Soda**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Cement Blast Guns (See Guns, Cement)****Cement Machinery**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp., 115 Broadway, New York City.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Chains**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Chemical Apparatus**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Chemicals**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Roeseler & Haaslaeber Chemical Co., 100 William St., New York City.

**Chrome Brick**

Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.

**Chute Plates & Launder Liners**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

**Chutes**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Classifiers**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Deister Concentrator Co., Fort Wayne, Ind.  
Dorr Co., Denver, Colo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Coal and Ash Handling Machinery**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Coal Mining Machines**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Coal Mining Plants**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Coal Storage and Rehandling Machinery**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Compass, Mass Patent Drill Hole**

Derby, Jr., E. L., Agent, Ishpeming, Mich.

**Compressors, Air**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Denver Hydro Co., 3100 Stuart St., Denver, Colo.  
General Electric Co., Schenectady, N. Y.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Concentrators**

Colorado Iron Works Co., Denver, Colo.  
Deister Concentrator Co., Fort Wayne, Ind.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Condensers, Surface**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Contractors, Diamond Drilling**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Converters, Copper**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Converters, Electric, Rotary**

General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Conveyors, Belt**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Robins Conveying Belt Co., Park Row Bldg., New York City.

**Conveyors, Cable Flight**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Chain Flight**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Pan or Apron**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Screw**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Core Drilling**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Crucibles**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.

**Crushers, Coal and Coke**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Crushers, Disc**

Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.

**Crushers, Jaw**

Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.

**Crushers, Ore**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Buchanan Co., C. G., 90 West St., New York City.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Fuller-Lehigh Co., Fullerton, Pa.  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Crushing and Grinding Machinery**

Chalmers & Williams, Inc., 1465 Arnold St.,  
Chicago Heights, Ill.

**Crushing Roll Parts**

American Manganese Steel Co., McCormick  
Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights,  
Ill.

**Crushing Rolls (See Rolls, Crushing)****Cupro-Vanadium**

Primos Chemical Co., Primos, Pa.

**Cyanide**

Roeseler & Haselacher Chemical Co., 100  
William St., New York City.

**Cyaniding Equipment**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights,  
Ill.

Colorado Iron Works Co., Denver, Colo.

Dorr Co., Denver, Colo.

Mine and Smelter Supply Co., 42 Broadway,  
New York City.

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

Traylor Engineering & Mfg. Co., Allentown,  
Pa.

Worthington Pump & Machinery Corp'n.,  
115 Broadway, New York City.

**Cyanide Plants**

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

**Dead Burned Magnesite**

Harbison-Walker Refractories Co., Farmers'  
Bank Bldg., Pittsburgh, Pa.

**Dewaterers**

Colorado Iron Works Co., Denver, Colo.

Dorr Co., Denver, Colo.

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

Traylor Engineering & Mfg. Co., Allentown,  
Pa.

**Diamond Drilling**

Longyear Co., E. J., 710 Security Bldg.,  
Minneapolis, Minn.

**Dredging Machinery**

Flory Mfg. Co., S., Bangor, Pa.

**Drill Hole Compass (See Compass, Drill Hole)****Drills, Core**

Longyear Co., E. J., 710 Security Bldg.,  
Minneapolis, Minn.

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Drills, Diamond**

Longyear Co., E. J., 710 Security Bldg.,  
Minneapolis, Minn.

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Drills, Electric**

General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
Ohio.

**Drills, Hammer**

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Drills, Prospecting**

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Drills, Rock**

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Dryers, Coal**

Ruggles-Coles Engineering Co., 50 Church  
St., New York City.

**Dryers, Ore**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Ruggles-Coles Engineering Co., 50 Church  
St., New York City.

Traylor Engineering & Mfg. Co., Allentown,  
Pa.

Wedge Mechanical Furnace Co., Greenwich  
Point, Philadelphia, Pa.

**Dryers, Rotary**

Fuller-Lehigh Co., Fullerton, Pa.

Ruggles-Coles Engineering Co., 50 Church  
St., New York City.

**Dryers, Sand and Gravel**

Ruggles-Coles Engineering Co., 50 Church  
St., New York City.]

**Dumps, Rotary**

Car Dumper and Equipment Co., McCor-  
mick Bldg., Chicago, Ill.

**Dynamite**

Atlas Powder Co., Wilmington, Del.

Du Pont de Nemours & Co., E. I., Wilming-  
ton, Del.

Hercules Powder Co., Wilmington, Del.

**Dynamos (See Generators, Electric)****Electrical Machinery**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

General Electric Co., Schenectady, N. Y.

Westinghouse Electric & Mfg. Co., East  
Pittsburgh, Pa.

**Elevators, Bucket**

Buchanan Co., C. G., 90 West St., New York  
City.

Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
Ohio.

Mine and Smelter Supply Co., 42 Broadway,  
New York City.

Robins Conveying Belt Co., Park Row Bldg.,  
New York City.

Traylor Engineering & Mfg. Co., Allentown,  
Pa.

Worthington Pump & Machinery Corp'n.,  
115 Broadway, New York City.

**End Loaders (See Loaders, End)****Engines, Gas and Gasoline**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Engines, Haulage**

Holmes & Bros., Inc., Robt., 30 N. Hazel St.,  
Danville, Ill.

**Engines, Hoisting**

Flory Mfg. Co., S., Bangor, Pa.

Holmes & Bros., Inc., Robt., 30 N. Hazel St.,  
Danville, Ill.

Vulcan Iron Works, 1744 Main St., Wilkes-  
Barre, Pa.

**Engines, Oil**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Worthington Pump & Machinery Corp'n.,  
115 Broadway, New York City.

**Engines, Steam**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Explosives**

Atlas Powder Co., Wilmington, Del.

Du Pont de Nemours & Co., E. I., Wilming-  
ton, Del.

Hercules Powder Co., Wilmington, Del.

**Fans, Ventilating**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
Ohio.

Vulcan Iron Works, 1744 Main St., Wilkes-  
Barre, Pa.

# CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

## Feeders, Ore

Buchanan Co., C. G., 90 West St., New York City.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown Pa.

## Ferro-Molybdenum

Primos Chemical Co., Primos, Pa.

## Ferro-Tungsten

Primos Chemical Co., Primos, Pa.

## Ferro-Vanadium

Primos Chemical Co., Primos, Pa.

## Filtering Paper

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## Filters

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## Fire Clay

Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.

## Flotation, Oil

Colorado Iron Works Co., Denver, Colo.

## Fluorescent Calcium Tungstate

Primos Chemical Co., Primos, Pa.

## Forgings, Heavy

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

## Fuller Mill Parts

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

## Furnaces, Assay

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.

## Furnaces, Electric

General Electric Co., Schenectady, N. Y.  
 Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## Furnaces, Mechanical Roasting

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Wedge Mechanical Furnace Co., Greenwich Point, Philadelphia, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Furnaces, Oil

Mine and Smelter Supply Co., 42 Broadway, New York City.

## Furnaces, Smelting

Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## Gears

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

## Generators, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

## Grinders, Sample

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## Grizzly & Riffle Bars (For Hydraulic Mines)

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

## Gyratory Crusher Parts

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.

## Hitchings Mine Car

Macomber & Whyte Rope Co., Kenosha, Wis.

## Hoisting Engines (See Engines, Hoisting)

## Hoists, Electric

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Flory Mfg. Co., S., Bangor, Pa.  
 General Electric Co., Schenectady, N. Y.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## Hoists, Skip

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## Hoists, Steam

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Flory Mfg. Co., S., Bangor, Pa.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## Hoppers, Weigh

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

## Hose, Air

Goodrich Rubber Co., B. F., Akron, O.

## Hydraulic Machinery

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

## Jackets, Water

Traylor Engineering & Mfg. Co., Allentown, Pa.

## Jaw Crusher Parts

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.

## Jigs

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Colorado Iron Works Co., Denver, Colo.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Kilns, Rotary**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Kilns, Rotary, Ore Nodulizers**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Laboratory Supplies**  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Lamps, Electric**  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Lead Acetate**  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Linings, Ball and Tube**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Litharge**  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Loaders, End**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Loading Booms**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Locomotives, Compressed Air**  
General Electric Co., Schenectady, N. Y.  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Electric Trolley**  
General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Locomotives, Gasoline**  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Steam**  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Storage Battery**  
General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Magnesia Brick**  
Harrison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Magnetic Pulleys (See Pulleys, Magnetic)**
- Metals, Perforated**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Motors, Electric**  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Mills, Ball, Tube and Pebble**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Fuller-Lehigh Co., Fullerton, Pa.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Mills, Chilean**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Mills, Stamp**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Mine Car Hitchings (See Hitchings, Mine Car)**
- Mining Machinery**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.
- Molybdate of Ammonia**  
Primos Chemical Co., Primos, Pa.
- Molybdate of Calcium**  
Primos Chemical Co., Primos, Pa.
- Molybdate of Soda**  
Primos Chemical Co., Primos, Pa.
- Molybdenum Metal**  
Primos Chemical Co., Primos, Pa.
- Molybdenum Ore, Buyers of**  
Primos Chemical Co., Primos, Pa.
- Molybdic Acid**  
Primos Chemical Co., Primos, Pa.
- Motors, Electric**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
General Electric Co., Schenectady, N. Y.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Muffles**  
Mine and Smelter Supply Co., 42 Broadway, New York City.
- Nodulizers**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Ore-Bedding Systems**  
Robins Conveying Belt Co., Park Row Bldg., New York City.
- Ore Handling Machinery**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.
- Ore Milling Machinery**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Ores, Buyers and Sellers of**  
Vogelstein & Co., Inc., L., 42 Broadway, New York City.
- Packings, Steam**  
Goodrich Rubber Co., B. F., Akron, O.
- Plate Metal Work**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Platinum Wire, Felt & Ware**  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Powder, Blasting**  
 Atlas Powder Co., Wilmington, Del.  
 Du Pont de Nemours & Co., E. 1., Wilmington, Del.  
 Hercules Powder Co., Wilmington, Del.
- Powdered Coal Equipment**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Ruggles-Coles Engineering Co., 50 Church St., New York City.
- Power Transmission Machinery**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Presses, Filter**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pulleys, Magnetic**  
 Buchanan Co., C. G., 90 West St., New York City.
- Pulveriser Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Pulverizers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Pulverizers, Coal and Coke**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pulverizers, Ore**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Acid**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Centrifugal**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Hydraulic Pressure**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Mine**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.
- Pumps, Pneumatic Air Lift**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Pumps, Power**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Sand**  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pumps, Sinking**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Stuff**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Track**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumping Engines (See Engines, Pumping)**
- Pyrometers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Quarrying Machinery**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Refractories**  
 Harbison-Walker Refractories Co., Farmers Bank Bldg., Pittsburgh, Pa.
- Respirators**  
 Goodrich Rubber Co., B. F., Akron, O.  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Revolving Screen Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.
- Rock Drill Steel (See Steel, Drill)**
- Rods, Drill**  
 International High Speed Steel Co., 99 Nassau St., New York, N. Y.
- Roller Mill Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Rolls, Crushing**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Rope, Wire**  
 Leachen & Sons Rope Co., A., 920 N. 1st St., St. Louis, Mo.  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Rope Fastenings, Wire**  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Rubber Goods, Mechanical**  
 Goodrich Rubber Co., B. F., Akron, O.
- Samplers, Ore**  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Scorifiers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Screens, Bar**  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Screens, Perforated Metal**  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Screens, Revolving**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Screens, Revolving (Continued)**  
 Worthington Pump & Machinery Corp'n.,  
 115 Broadway, New York City.
- Screens, Shaking**  
 Chalmers & Williams, Inc., 1465 Arnold St.  
 Chicago Heights, Ill.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St.,  
 Danville, Ill.
- Separators, Magnetic**  
 Buchanan Co., C. G., 90 West St., New York  
 City.
- Shaft Sinking and Development Work**  
 Longyear Co., E. J., 710 Security Bldg.,  
 Minneapolis, Minn.
- Sharpeners, Drill**  
 Sullivan Machinery Co., 122 So. Michigan  
 Ave., Chicago, Ill.
- Silica Brick**  
 Harrison-Walker Refractories Co., Farmers'  
 Bank Bldg., Pittsburgh, Pa.
- Skip Hoists (See Hoists, Skip)**  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Slime Filters (See Filters)**
- Smelters**  
 Vogelstein & Co., Inc., L., 42 Broadway,  
 New York City.
- Smelting Machinery**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown,  
 Pa.  
 Worthington Pump & Machinery Corp'n.,  
 115 Broadway, New York City.
- Soda Ash**  
 Hall Chemical Co., Henry, 210-214 S. 4th St.,  
 St. Louis, Mo.
- Spelter**  
 Illinois Zinc Co., Peru, Ill.
- Sprockets**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.
- Stamp Mill Parts**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights,  
 Ill.
- Steel, Drill, Hollow and Solid**  
 International High Speed Steel Co., 99 Nas-  
 sau St., New York, N. Y.  
 Sullivan Machinery Co., 122 So. Michigan  
 Ave., Chicago, Ill.
- Steel, Tool**  
 International High Speed Steel Co., 99 Nas-  
 sau St., New York, N. Y.
- Stokers**  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Switchboards**  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Tables, Concentrating (See Concentrators)**
- Tanks, Cyanide**  
 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Tanks, Oil**  
 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Tanks, Water**  
 National Tank & Pipe Co., 275 Y Oak St.,  
 Portland, Ore.
- Test Lead**  
 Hall Chemical Co., Henry, 210-214 S. 4th St.,  
 St. Louis, Mo.
- Thermometers**  
 Hall Chemical Co., Henry, 210-214 S. 4th St.,  
 St. Louis, Mo.
- Thickeners, Slime**  
 Colorado Iron Works Co., Denver, Colo.  
 Dorr Co., Denver, Colo.
- Tipple Machinery Equipment**  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
 Ohio.
- Towers and Bridges, Stocking and Reclaiming**  
 Robins Conveying Belt Co., Park Row Bldg.,  
 New York City.
- Tramways, Wire Rope, Aerial**  
 Leach & Sons Rope Co., A., 920 N. 1st St.,  
 St. Louis, Mo.  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Transformers, Electric**  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Tungstate of Ammonia**  
 Primos Chemical Co., Primos, Pa.
- Tungstate of Soda**  
 Primos Chemical Co., Primos, Pa.
- Tungsten Ore, Buyers of**  
 Primos Chemical Co., Primos, Pa.
- Tungstic Acid**  
 Primos Chemical Co., Primos, Pa.
- Turbines, Hydraulic**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Turbines, Steam**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East  
 Pittsburgh, Pa.
- Valves, Pump**  
 Goodrich Rubber Co., B. F., Akron, O.
- Vanadate of Ammonia**  
 Primos Chemical Co., Primos, Pa.
- Vanadic Acid**  
 Primos Chemical Co., Primos, Pa.
- Vanadium Chloride**  
 Primos Chemical Co., Primos, Pa.
- Vanadium Ore, Buyers of**  
 Primos Chemical Co., Primos, Pa.
- Ventilating Fans (See Fans, Ventilating)**
- Wagon Loaders**  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
 Ohio.
- Weigh Hoppers (See Hoppers, Weigh)**
- Wheels**  
 American Manganese Steel Co., McCormick  
 Bldg., Chicago, Ill.
- Wheels, Mine Car**  
 Fuller-Lehigh Co., Fullerton, Pa.
- Wire, Iron, Steel and Copper**  
 Roebling's Sons Co., John A., Trenton, N. J.
- Wire Mechanism (Lever Control)**  
 William Co., 283 W. 58th St., New York  
 City.
- Wire Rope (See Rope, Wire)**
- Wires and Cables, Electrical**  
 General Electric Co., Schenectady, N. Y.  
 Goodrich Rubber Co., B. F., Akron, O.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Zinc Dust**  
 Vogelstein & Co., Inc., L., 42 Broadway,  
 New York City.
- Zinc Sheet**  
 Illinois Zinc Co., Peru, Ill.

# ALPHABETICAL LIST OF ADVERTISERS

(With Summary of Products)

See pages 41-47 for Classified List of Mining and Metallurgical Equipment

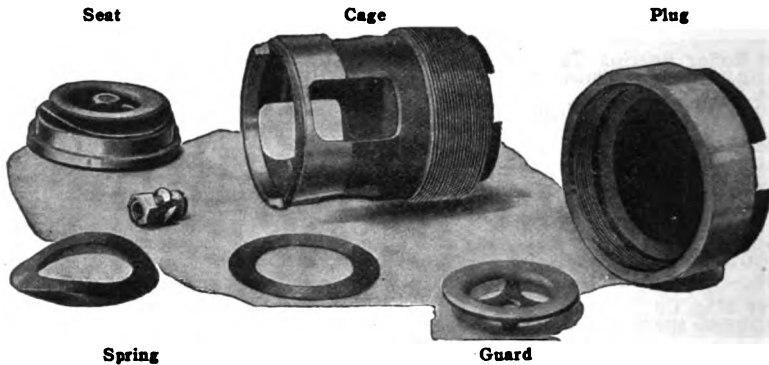
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|--|------|--|------|
| Allis-Chalmers Mfg. Co.....                | *    | Epping-Carpenter Pump Co.....                | 17   |
| ADDRESS: Milwaukee, Wis.                   |      | ADDRESS: Pittsburgh, Pa.                     |      |
| PRODUCTS: Mining Machinery of Every        |      | PRODUCTS: Pumping Machinery and              |      |
| Type. Complete Power and Electrical        |      | Condensers.                                  |      |
| Equipments.                                |      |  |      |
| American Manganese Steel Co.....           | *    | Flory Mfg. Co., S.....                       | *    |
| ADDRESS: McCormick Building, Chi-          |      | ADDRESS: Bangor, Pa.                         |      |
| cago, Ill.                                 |      | PRODUCTS: Mine and Contractors'              |      |
| PRODUCTS: Castings for Mining Ma-          |      | Hoists, Cableways, Capstans, Winches,        |      |
| chinery Parts.                             |      | Marine Railway Hoists, etc.                  |      |
| Atlas Powder Co.....                       | 11   | Fuller-Lehigh Co.....                        | 29   |
| ADDRESS: Wilmington, Del.                  |      | ADDRESS: Fullerton, Pa.                      |      |
| PRODUCTS: Manufacturers of Explosives.     |      | PRODUCTS: The Fuller-Lehigh Pulveriser       |      |
|  |      | Mill, Cement Mill Machinery, Powdered        |      |
| Buchanan Co., C. G.....                    | *    | Coal Equipment, Gyratory Crushers, Roll      |      |
| ADDRESS: 90 West St., New York City.       |      | Crushers, Rotary Dryers, Car Wheels and      |      |
| PRODUCTS: Crushing and Magnetic Con-       |      | Axles, Chemical Castings, Charcoal Iron      |      |
| centrating Plants Complete in All Details. |      | Castings, Chilled Castings.                  |      |
| Rock and Ore Crushers, Crushing Rolls,     |      |  |      |
| Magnetic Separators, Revolving Screens,    |      | General Electric Co.,                        |      |
| Bucket Elevators, Ore Feeders.             |      | Outside Back Cover                           |      |
| Car Dumper and Equipment Co.....           | *    | ADDRESS: Schenectady, N. Y.                  |      |
| ADDRESS: McCormick Bldg., Chicago, Ill.    |      | PRODUCTS: Electric Mine Locomotives.         |      |
| PRODUCTS: The Pneumatic Rotary             |      | Electric Motors for Operating Mining         |      |
| Dump (Wood and Ramsay Patents).            |      | Machinery.                                   |      |
| Adaptable to all mining conditions—old or  |      |  |      |
| new operations.                            |      | Goodrich Rubber Co., B. F.,                  |      |
| Chalmers & Williams, Inc.....              | *    | Inside Back Cover                            |      |
| ADDRESS: 1465 Arnold St., Chicago          |      | ADDRESS: Akron, O.                           |      |
| Heights, Ill.                              |      | PRODUCTS: Goodrich "Longlife,"               |      |
| PRODUCTS: Mining and Crushing Ma-          |      | "Dredge," Vanner, Take-off and Mag-          |      |
| chinery.                                   |      | netic Separator Conveyor Belts.              |      |
| Colorado Iron Works Co.,                   |      | Gwilliam Co.....                             | *    |
| Inside Front Cover                         |      | ADDRESS: 263 W. 58th St., New York City      |      |
| ADDRESS: Denver, Colo.                     |      | PRODUCTS: Ball and Roller Bearings           |      |
| PRODUCTS: Complete Equipment for           |      | The Bowden Patent Wire Mechanism for         |      |
| Cyanide and Concentrating Mills and        |      | the Transmission of Reciprocating Motion     |      |
| Smelting Plants.                           |      | Through a Flexible and Tortuous Route.       |      |
| Deister Concentrator Co.....               | *    | Harbison-Walker Refractories Co....          | *    |
| ADDRESS: Ft. Wayne, Ind.                   |      | ADDRESS: Pittsburg, Penna.                   |      |
| PRODUCTS: Deister, Overstrom and           |      | PRODUCTS: Refractories for Blast             |      |
| Deister-Overstrom Tables in either Single  |      | Furnace and the Open Hearth, Electrical      |      |
| or Double Deck Types.                      |      | Furnaces, Copper Smelting Plants, Lead       |      |
| Denver Hydro Co.....                       | *    | Refineries, Nickel Smelters, Silver Slimes   |      |
| ADDRESS: 3100 Stuart St., Denver, Colo.    |      | and Dross Furnaces, Alloy Furnaces, as well  |      |
| PRODUCTS: Hydraulic Air Compressors,       |      | as all other types in use in the various     |      |
| Excelsior Airometers, The Sentinel Auto-   |      | metallurgical processes.                     |      |
| matic Valve.                               |      |  |      |
| Derby, Jr., E. L., Agent.....              | *    | Heil Chemical Co., Henry.....                | *    |
| ADDRESS: Ishpeming, Mich.                  |      | ADDRESS: 210-214 S. 4th St., St. Louis,      |      |
| PRODUCTS: The Maas Drill Hole Com-         |      | Mo.  |      |
| pass for determining direction and dip.    |      | PRODUCTS: Chemicals and Chemical             |      |
| Dorr Co.....                               | 33   | Apparatus. Supplies for Mines, Smelters,     |      |
| ADDRESS: Denver, Colo.                     |      | Iron and Steel Works, Schools, Colleges, and |      |
| PRODUCTS: Machinery in use for Cyanid-     |      | Universities.                                |      |
| ing. Wet Gravity Concentration, Flota-     |      |  |      |
| tion. Leaching Copper Ores and many non-   |      | Hercules Powder Co.....                      | *    |
| metallurgical industrial processes.        |      | ADDRESS: Wilmington, Del.                    |      |
| Du Pont de Nemours & Co., E. I.,... 13     |      | PRODUCTS: Explosives, Blasting Powder,       |      |
| ADDRESS: Wilmington, Del.                  |      | Dynamite, etc.                               |      |
| PRODUCTS: Explosives, Blasting Powder,     |      |  |      |
| Dynamite, etc.                             |      | Holmes & Bros., Inc., Robt.....              | 15   |
|  |      | ADDRESS: 30 N. Hazel St., Danville, Ill.     |      |
|  |      | PRODUCTS: Engineers, Founders, Ma-           |      |
|  |      | chinalists and Boiler Makers. Builders of    |      |
|  |      | Hoisting and Haulage Engines, Shake          |      |
|  |      | Screens and Weigh Hoppers, Self Dumping      |      |
|  |      | Cages and Empty Car Lifts, Mill and Mine     |      |
|  |      | Supplies.                                    |      |

\*Advertisement does not appear in this issue, but products are listed in Classified List of Mining and Metallurgical Equipment.

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| <b>Hyatt Roller Bearing Co.</b> .....   | 21   | <b>Primos Chemical Co.</b> .....   | *      |
| ADDRESS: Metropolitan Tower, New York.  |      | ADDRESS: Primos, Pa.   |        |
| PRODUCTS: Roller Bearings.  |      | PRODUCTS: Molybdenum, Tungsten and Vanadium Products. Buyers of Molybdenum, Tungsten and Vanadium Ores.  |        |
| <b>Illinois Zinc Co.</b> .....  | *    | <b>Robins Conveying Belt Co.</b> .....   | *      |
| ADDRESS: Peru, Ill.   |      | ADDRESS: Park Row Bldg., New York City.  |        |
| PRODUCTS: Spelter, Sheet Zinc and Sulphuric Acid.   |      | PRODUCTS: Belt Conveyors, Bucket Elevators, Ore Bedding Systems, Unloading, Stocking and Reclaiming Towers and Bridges, Conveyor Auxiliaries.  |        |
| <b>International High Speed Steel Co.</b> ...   | 7    | <b>Roebbing's Sons Co., John A.</b> .....  | 5      |
| ADDRESS: 99 Nassau St., New York City.  |      | ADDRESS: Trenton, N. J.  |        |
| PRODUCTS: Drill Steel, Tool Steel, Drill Rods.  |      | PRODUCTS: Wire Rope for Mining Work. Stock shipments from agencies and branches throughout the country.  |        |
| <b>Jeffrey Mfg. Co.</b> .....   | *    | <b>Roessler &amp; Hasslacher Chemical Co.</b> *  |        |
| ADDRESS: 902 N. Fourth St., Columbus, O.  |      | ADDRESS: 100 William St., New York.  |        |
| PRODUCTS: Electric Coal Cutters and Drills; Electric and Storage Battery Locomotives; Coal Tipple Machinery including Elevators, Conveyors, Pickling Tables and Loading Booms, Car Hauls, Car Dumps, Screens, Crushers, Pulverisers, Fans, Hoists, etc. |      | PRODUCTS: Cyanide of Sodium and Other Chemicals for Mining Purposes.   |        |
| <b>Johns-Manville Co., H. W.</b> .....  | *    | <b>Ruggles-Coles Engineering Co.</b> .....   | 31     |
| ADDRESS: New York City.   |      | ADDRESS: 50 Church Street, New York.   |        |
| PRODUCTS: Asbestos and Rubber-type Roofings, Roof Coating, Steam Packings, Pipe Insulations, Cements, Brake Lining and Brake Blocks, Steam Traps, Third Rail Insulators, Mine Hangers, Moulded Mica Weatherproof Sockets, Electrical Tapes and Fuses.   |      | PRODUCTS: Manufacturers of the Ruggles-Coles Dryer for All Materials. Powdered Coal Equipment.   |        |
| <b>Leschen &amp; Sons Rope Co., A.</b> .....  | *    | <b>Sullivan Machinery Co.</b> .....  | 50     |
| ADDRESS: St. Louis, Mo.   |      | ADDRESS: 122 S. Michigan Ave., Chicago, Ill.   |        |
| PRODUCTS: Wire Rope for all purposes, including Hercules Red Strand Wire Rope, and Wire Ropes of Patent Flattened Strand and Locked Coil constructions. Aerial Wire Rope Tramways for economical transportation of material.                            |      | PRODUCTS: Coal Pick Machines, Air Compressors, Diamond Core Drills, Rock Drills, Hammer Drills, Mine Hoists, Chain Cutter, Bar Machines, Fans.   |        |
| <b>Longyear Co., E. J.</b> .....  | 9    | <b>Taylor Engineering &amp; Mfg. Co.</b> .....   | 25     |
| ADDRESS: 710 Security Bldg., Minneapolis, Minn.   |      | ADDRESS: Allentown, Pa.  |        |
| PRODUCTS: Contract Diamond Drilling, Manufacture of Diamond Drills and Supplies, Shaft Sinking and Development Work, Geological Department.   |      | PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.   |        |
| <b>Macomber &amp; Whyte Rope Co.</b> .....  | *    | <b>Vogelstein &amp; Co., Inc., L.</b> .....  | *      |
| ADDRESS: Kenosha, Wis.  |      | ADDRESS: 42 Broadway, New York.  |        |
| PRODUCTS: Monarch Whyte Strand Wire Rope, Patent Killind Non-Rotating Wire Rope. Wire Rope of all Grades and Constructions. Patent Monarch Mine Car Hitchings.  |      | PRODUCTS: Buyers, Smelters and Refiners of Ores and Metals of all classes.   |        |
| <b>Mine &amp; Smelter Supply Co.</b> .....  | 23   | <b>Vulcan Iron Works.</b> .....  | *      |
| ADDRESS: 42 Broadway, New York City.  |      | ADDRESS: Wilkes-Barre, Pa.   |        |
| PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.  |      | PRODUCTS: Vulcan Electric Mine Hoists, Steam Hoists, Hoisting and Haulage Engines, Mining Machinery, etc. Nicholson Device for Prevention of Overwinding.  |        |
| <b>National Tank &amp; Pipe Co.</b> .....   | *    | <b>Wedge Mechanical Furnace Co.</b> .....  | 35     |
| ADDRESS: 275 Y Oak St., Portland, Ore.  |      | ADDRESS: Greenwich Point, Philadelphia, Pa.  |        |
| PRODUCTS: Water, Oil, Mining and Cyanide Tanks; Cross Arms and Silos.   |      | PRODUCTS: The Wedge Mechanical Roasting Furnace (Patented).  |        |
| <b>Obermayer Co., S.</b> .....  | *    | <b>Westinghouse Electric &amp; Mfg. Co.</b> ... 19   |        |
| ADDRESS: Pittsburgh, Pa.  |      | ADDRESS: East Pittsburgh, Pa.  |        |
| PRODUCTS: Foundry Parting, High Temperature Cement.   |      | PRODUCTS: The Baldwin-Westinghouse Electric Mine Locomotives. Electrical Machinery: Turbines, Generators, Motors, etc.   |        |
| <b>Portable Machinery Co.</b> .....   | *    | <b>Worthington Pump and Machinery Corp'n.</b> .....  | 17, 27 |
| ADDRESS: Passaic, N. J.   |      | ADDRESS: 115 Broadway, New York.   |        |
| PRODUCTS: Manufacturers of the Scoop Conveyor.  |      | PRODUCTS: Laidlaw Feather Valve Air Compressors, Direct Acting and Centrifugal Pumps, Power Pumps, Rock and Ore Crushers, Crushing Rolls, Tube Mills, Converters, Woodbury Jigs, Snow Oil Engines. |        |

\*Advertisement does not appear in this issue, but products are listed in Classified List of Mining & Metallurgical Equipment.



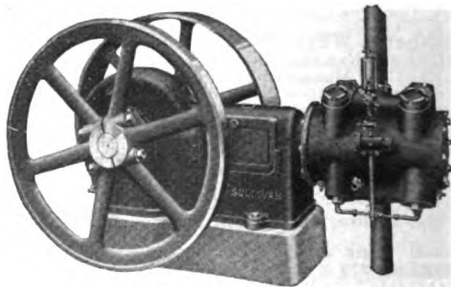
## Sullivan Wafer Valves for WG-6 Compressors

Light, thin steel discs, held to their seat by flat springs of the same material, form the valves of Sullivan WG-6 single stage belted compressors.

Wide, short, port opening, lightness, low lift, simplicity and long life are "Wafer" valve features which help to make the service rendered by these small Sullivan Compressors more efficient, more dependable and more economical than ever—

### Bulletin 875-G

(Wafer Valves are operating successfully in Sullivan Torpedo Charging Compressors, under 2500 pounds pressure.)



Sullivan WG-6 Air Compressor

## SULLIVAN MACHINERY CO.

122 South Michigan Avenue, Chicago, Ill.

30 Church Street, New York

# MINING AND METALLURGY

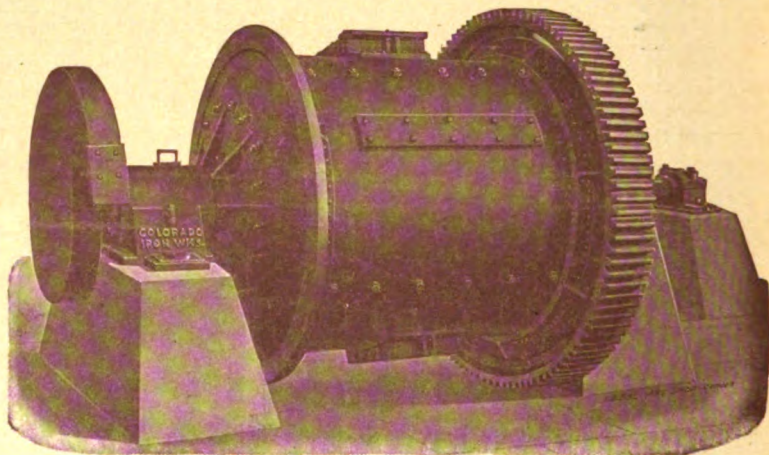
BULLETIN OF THE  
AMERICAN INSTITUTE OF MINING  
*and* METALLURGICAL ENGINEERS  
WITH WHICH IS CONSOLIDATED THE  
AMERICAN INSTITUTE OF METALS



## SPECIAL FEATURES

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# MINING AND METALLURGY

Bulletin of the American Institute

of

## Mining and Metallurgical Engineers

with which is consolidated the

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### THE ENGINEERS PRIMARY PARTICIPATION IN PUBLIC AFFAIRS

All branches of our profession may look back with pride upon the patriotic service rendered by engineers during the war. That war has been won. The mortal danger which it threatened has been averted. But the effects of the torture inflicted by it still remain, a fever in the blood of the body politic.

Fever begets delirium and, unless its course be checked, has a tendency to produce convulsions. The only safe course is to take immediate steps to allay the fever.

The seat of the present trouble is industrialism; as production is at the foundation of civilization, a diseased condition there carries pain and consequent unrest into every member of the organism.

Who shall supply the cure? Quack doctors, nostrums in hand, rush forward from all directions promising to perform miracles. But sane men know that no miracles, though invoked by star gazers of purest intention, will prevent or accelerate the orderly operations of the laws of nature and of human life.

Delirium must be controlled by the firm, gentle hand of intelligent, sympathetic authority. Fever must be allayed first by removal of all poisons from the system, then by consistent ministration of cooling, quieting restoratives, then by simple, wholesome nourishment. Nature will, under such treatment, supply the permanent cure.

But the treatment must emanate from and be administered by human beings, wise with the knowledge gained through practical experience.

What class among our citizens has had most training in practical care, through sickness and in health, of productive industry?

Government, in a democracy, is the fruit of politics. It can be improved or debased only through the activities of those citizens who voluntarily or through inducement of their fellows, take part in politics. Voting is the simplest, most universal, and of course most important element of politics; but it is never a sufficient part for a true patriot; and now it is but one of many political duties incumbent upon engineers. We and our brethern of the civil, mechanical, electrical, chemical and all other branches of our profession; all manufacturers, superintendents, plant managers; all men, whether nominal engineers or not, who have skill born of experience in keeping wheels turning and production up to schedule, in employing, treating justly and satisfying honest American labor, have political duties now which we must not shirk.

These duties lie in the primaries; in local, county, state and national committees; in party conventions; on the stump and in the columns of the press.

When public ills were caused by unjust laws, lawyers became active in politics. Such conditions have been most usual and we have come to feel that government was the special affair of lawyers, since members of that profession have been best trained by study and experience to adapt laws to principles of justice. But now, when the most pressing public danger is caused by breakdown of the system of production, the engineer in his turn must step forward and help supply the remedy.

Let us become awake to our obligations. We solicit discussion, suggestions, expressions of opinion from our members on this vital subject. To our sister organizations we offer an invitation to join with us in arousing all engineers and all other sound thinking patriots, whose experience will be of value in the present crisis, to the obligation of re-enlistment in the public service until industrial peace shall have been restored.

J. N. BLAIR.

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### FRANCO-AMERICAN ENGINEERING COMMITTEE

In order to assist in the building up of the industries and commerce of France, by coöperating with the *Congres General du Génie Civil*, the four Founder Societies have appointed the following committee: E. G. Spilsbury and Arthur S. Dwight representing the American Institute of Mining and Metallurgical Engineers; George F. Swain and Nelson P. Lewis to represent the American Society of Civil Engineers; Charles T. Main and George W. Fuller to represent the American Society of Mechanical Engineers; Lewis B. Stillwell and Andrew M. Hunt to represent the American Institute of Electrical Engineers.

## INCREASED COST OF RUNNING THE INSTITUTE

Owing to circumstances which are entirely unavoidable, the cost of rendering to Institute Members the services which they have been accustomed to expect from the Institute has increased enormously, especially during the past year. The cost of printing has increased 20 per cent. and another 30 per cent. is expected. There is no recourse; the Institute must pay this or cease publishing. The increase for supplies and office force will be very great. Justice to our employees, whose cost for living expenses has risen by leaps and bounds, demands an increase in wages, wholly aside from the fact that the employees need not and will not stay.

The Institute is, therefore, faced with the alternative of greatly reducing its service to the members or else of asking from them a small increase in dues. An amendment to the Constitution has been offered by the members increasing the dues to \$15 per year, which cannot become effective until 1921. This still leaves us as the engineering society with the lowest annual dues, except only one, whose dues are \$15 per year. To help meet the immediate emergency, the Directors have exercised the authority vested in them by the Constitution and By-Laws and requested the members to pay \$3.00 for the Transactions to be issued during the year 1920, which is very much less than the cost of publication. It is the opinion of the Board that the members will prefer to pay this slightly additional expense rather than to have the Institute take a backward step in respect to the services which it is rendering, and which has been increasing constantly in amount, as well as in unit cost, during the past seven or eight years.

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## 1920 DUES

In accordance with the provision of the Constitution, notice is here given to all Members, Associates, and Junior Associates, that the dues of the year 1920 will be payable on Jan. 1, 1920, at the office of the Secretary. The dues for Members and Associates are \$12 per year. The Transactions, according to the recent action of the Board of Directors, will be \$3 a year until such time as the dues are raised to \$15. The sum of \$3 additional is asked of those Members and Associates who desire to have the three volumes bound in the Institute's standard binding.

---

## PATENTS AND TRADE-MARKS

The Institute acknowledges the gift of two interesting and valuable pamphlets, one on Patents, and the other on Trade-marks, giving the digest of the United States laws and practice and also the digest of practice of foreign countries and the schedule of charges both here and abroad. This should be particularly interesting and valuable to our many mill men and metallurgists who are developing modern metallurgical machinery and processes.

**MEETING OF THE BOARD OF DIRECTORS OCT. 30, 1919**

There were present eleven Directors, the Institute's Legal Counsel, the Secretary, the Assistant Secretary, and twenty-three guests.

The Report of the Committee on Nominations (listed elsewhere) was presented and ordered to take the statutory course.

The appointment of a Committee on Mine Taxation was approved.

An Advertising Manager was appointed.

E. G. Spilsbury and A. S. Dwight were appointed as representatives of this Institute on the Franco-American Engineering Committee.

The *Transactions* were presented to the University of Louvain, and the monthly *Bulletin* to the French Technical Index.

Permission was given to publish in full the argument of William H. Shockley on simplified spelling.

A committee was appointed to have charge of the publication of the Raymond Memorial Volume.

There were elected 70 members, 15 associates, and 1 junior associate. Three members were reinstated and the resignations of two were accepted. The dues of 10 members who had been in active service with the allied armies were remitted. An extension of time for the payment of dues was granted to the 11 members.

The Report of the Treasurer and Finance Committee was presented.

On the recommendation of the Founder Societies' Finance Committee on Joint Activities, it was resolved to approve the separation of the Employment Bureau from the Engineering Council, and to provide an annual appropriation for the work of the American Engineering Standards Committee of \$500 for each of the Institute's three representatives.

The proposal to amend By-law XIII. received ten affirmative and one negative vote.

A petition to amend the Constitution by raising the dues of members from \$12 to \$15 and of Junior Associates from \$5 to \$6 was approved and ordered to take the statutory course.

The meeting was adjourned, subject to the call of the Secretary. The adjourned meeting was held on Nov. 10, 1919, there being fourteen Directors present; they unanimously voted to amend By-law XVI. so as to make a charge to the members of \$3.00 per year for the Institute *Transactions*, until such a time as the dues are raised to \$15.

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**FATIGUE PHENOMENA OF METALS**

Arrangements have been made for a coöperative investigation of the fatigue phenomena of metals by the University of Illinois, the Engineering Foundation, and the National Research Council. The work will be done in the laboratories of the Engineering Experiment Station, the Committee on the Fatigue Phenomena of Metals of the National Research Council acting as an advisory committee.

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Reports sent by operators of manganese mines to United States Geological Survey, covering the first three months of 1919, show that shipments of manganese ore during that quarter were much smaller than during any other quarter since 1917.

## REPORT OF THE A. I. M. E. COMMITTEE ON FEDERAL TAXATION OF MINES

The General Committee met in the Treasury Building at Washington on Oct. 6 and 7. At the first meeting, Cornelius P. Kelley was appointed chairman, and Paul Armitage, secretary. Sub-committees were appointed on Invested Capital, Mine Valuation, and Depletion and Depreciation. On Oct. 7, the reports of these committees were submitted to the General Committee and were referred to the Executive Committee.

A motion was carried that the Executive Committee be constituted a permanent committee to continue the work of the Committee, with full power to add to and increase its membership, that as thus increased, it should constitute a permanent organization to act and coöperate with the Treasury Department in matters of mining taxation under the Federal Income and Excess Profits Tax Laws. Thereafter the Executive Committee met and formed a permanent committee as follows:

Cornelius F. Kelley, chairman, 42 Broadway, New York City.

J. L. Darnell, office of the Commissioner of Internal Revenue, Washington, D. C.

J. Parke Channing, 61 Broadway, New York City.

Walter Douglas, 99 John St., New York City.

R. V. Norris, 542 Second National Bank Bldg., Wilkes-Barre, Pa.

J. E. Spurr, *Engineering and Mining Journal*, 10th Ave., and 36th St., New York City.

W. G. Swart, 808 Selwood Bldg., Duluth, Minn.

J. P. Finley, 45 Cedar St., New York City.

W. A. Williams, Bartlesville, Okla.

F. S. Peabody, Peabody Coal Co., McCormick Bldg., Chicago, Ill.

Matthew C. Fleming, 71 Broadway, New York City.

H. B. Fernald, 54 Wall St., New York City.

William G. Mather, Cleveland, Ohio.

Walter Fitch, Eureka, Utah.

Arthur Thacher, 900 Security Bldg., St. Louis, Mo.

John P. Gray, Coeur d'Alene, Idaho.

Paul Armitage, secretary, 233 Broadway, New York City.

At this meeting the Executive Committee appointed chairmen of sub-committees, each of said chairmen to appoint and select a sub-committee either from the members of the Executive Committee or otherwise, said sub-committee to take up the special questions relating to the particular subject and report to the General Committee. The chairmen appointed were:

H. V. Norris, chairman of the Sub-committee on Coal.

W. G. Swart, chairman of the Sub-committee on Iron.

J. Parke Channing, chairman of the Sub-committee on Copper.

J. P. Finley, chairman of the Sub-committee on Lead and Zinc.

J. E. Spurr, chairman of the Sub-committee on Precious Metals.

Matthew C. Fleming, chairman of the Sub-committee on Law.

H. B. Fernald, chairman of the Sub-committee on Accounting.

The Committee thereupon adjourned to meet at Atlantic City on Oct. 20 and 21, when the various sub-committees made their reports.

After a full discussion, the following were adopted as the recommendations of the Committee to the Bureau of Internal Revenue:

### INVESTED CAPITAL

On the subject of invested capital, the Committee recommends as follows:

#### *Revenue Act of 1917*

That Art. 63 of Regulations 41 be amended by striking out the following lines:

The adopted value shall not cover mineral deposits or other properties discovered or developed after the date of conveyance, but shall be confined to the value accurately ascertainable or definitely known at that time.

And by adding to said Art. 63 of said Regulations 41 the following paragraph dealing with "surplus:"

But in the case of mines and mineral deposits, where legitimate expenditures have been made for the purpose of developing known orebodies, or mineral deposits, and ascertainable values have been added to the property, or where as a result of development undertaken, exploration conducted, or the adaptation of improved processes, deposits or portions thereof unknown or without value at the date when the mining property was acquired, or which were not then susceptible of most efficient beneficiation have been developed and given a value or an additional value which can be ascertained with reasonable accuracy, such value shall be regarded as surplus and shall be included in invested capital.

Art. 63 as amended would therefore read as follows:

*When tangible property may be included in surplus:* Where it can be shown by evidence satisfactory to the Commissioner of Internal Revenue that tangible property has been conveyed to a corporation or partnership by gift or at a value, accurately ascertainable or definitely known as at the date of conveyance, clearly and substantially in excess of the cash or the par value of the stock or shares paid therefor, then the amount of the excess shall be deemed to be paid-in surplus.

Evidence tending to support a claim for a paid-in surplus under these circumstances must be as of the date of conveyance, and may consist, among other things, of (1) an appraisal of the property by disinterested authorities, (2) the assessed value in the case of real estate, and (3) the market price in excess of the par value of the stock or shares.

But in the case of mines and mineral deposits, where legitimate expenditures have been made for the purpose of developing known orebodies, or mineral deposits, and ascertainable values have been added to the property, or where as a result of development undertaken, exploration conducted, or the adaptation of improved processes, deposits or portions thereof unknown or without value at the date when the mining property was acquired, or which were not then susceptible of most efficient beneficiation, have been developed and given a value or an additional value which can be ascertained with reasonable accuracy, such value or additional value shall be regarded as surplus and shall be included in invested capital.

The Committee understands that the above regulation as to paid-in surplus applies irrespective of the date at which the surplus was paid in, whether before or after January 1, 1914.

It understands that Art. 55 of Regulations 41 has no bearing whatever on the question of "Paid-in-surplus," but was inserted in the regulations solely for the purpose of making clear the fact that property acquired before January 1, 1914, at a value less than the par of the stock issued therefor, may be valued as of January 1, 1914, it being, as the article states, one of the few cases in which the law permits allowance to be made for appreciation.

Your Committee is of the opinion that, if proper allowance be made for surplus as above defined, many of the objections heretofore raised to section 207 of the Act of 1917 on the ground of inequality and discrimination in taxation will be obviated.

### *Revenue Act of 1918*

We suggest one amendment, which we regard as important and which, if adopted, will bring the definition of invested capital under the Act of 1918 into line with that suggested above under the Act of 1917.

We, therefore, suggest that Art. 838 of Regulations 45 be amended by adding at the end thereof the following:

But in the case of mines and mineral deposits, where legitimate expenditures have been made for the purpose of developing known orebodies, or mineral deposits, and ascertainable values have been added to the property, or where, as a result of development undertaken, exploration conducted, or the adaptation of improved processes, deposits or portions thereof unknown or without value at the date when the mining property was acquired, or which were not then susceptible of most efficient beneficiation, have been developed and given a value or an additional value which can be ascertained with reasonable accuracy, such value or additional value shall be regarded as surplus and shall be included in invested capital; such earned value not being "value appreciation" within the meaning of the last paragraph of Article 844.

## II. VALUATION OF MINES

The Committee arrived at the conclusion that it would be desirable to divide mineral properties into two classes; Class I and Class II.

In Class I are included mineral properties in which the tonnage or other unit has been determined with reasonable accuracy.

In Class II are to be included all other deposits.

As to Class I, the Committee considered methods of arriving at the present value of mineral property, and methods of depletion, and has arrived at the following conclusions:

A proper value of a mining property is the present value of the prospective net earnings taking into account probable variations in output and value discounted by recognized sinking-fund methods at a fair rate of interest with sinking fund at 4 per cent. interest, or by calculations by standard annuity methods. But other recognized methods of valuation acceptable to the Department may be used.

In lieu of estimated net earnings, where mining on a royalty basis is customary, royalty prices may be used in valuation taking into consideration the trend of such prices.

No mine shall be valued on an estimated operating life exceeding 45 years.

Ores of different grades, location, and probable time of extraction in a mining property may be classified separately and valued accordingly.

Nothing herein contained shall be understood to prescribe a method of valuing separately the equities of lessor and lessees in a mining property.

Mines in Class II may be valued in the manner prescribed for Class I, but there will be a difference in the manner of determining the principal underlying factors, namely, the quantity and quality of ore and the life of the mine.

In Class II, sole reliance cannot be placed in the development of ore on the date of valuation, but concurrent evidence, such as the habit and type of orebodies in the mine itself, the characteristics of the district in

which it occurs, the rate of development through exploration, the strength of mineralization, the stage of the operating life of the mine and any other satisfactory evidence may be used to establish a reasonable estimate of the required factors.

### III. DEPLETION

On the question of depletion, the Committee makes the following recommendations:

Depletion should be a sum calculated to return to the owner, free of tax, the cost or value, as the case may be, of his mineral property.

This should be calculated either on a unit basis by dividing the estimated value or cost by the estimated units, or as a percentage of the annual income before deducting depletion, the said percentage to be the ratio of the cost or value of the property to the total estimated earnings.

The Committee is of the opinion that in view of the fact that the equitable apportionment of depletion between lessor and lessee depends in large measure on the terms and construction of the contract of lease, and of the law, no recommendation should be made by the Committee until the legal questions have first been satisfactorily and authoritatively determined.

The Committee recommends that distributions to stockholders made from depletion reserve are liquidating dividends, and do not constitute taxable income to a stockholder; and that said distribution under the law may be made from such reserve irrespective of the condition of the surplus and undivided profits account of the corporation.

The Committee is of the opinion that to prohibit such distribution until the surplus and undivided profits of the corporation have been first distributed, works a grave injustice to stockholders of mining corporations and is contrary to the letter and spirit of the revenue law.

### IV. DISCOVERY

On the question of discovery, the Committee recommends as follows:

(1) That Article 219 of Regulations 45 as revised, be approved, and that it be amended by inserting after the words "proving and development" at the end of the first paragraph thereof, a new sub-division to be known as sub-division (c), to read as follows:

(c) the proving by the taxpayer of the commercial value of a mineral or ore deposit by the development, refinement or perfection of known methods or processes of mining or metallurgy, or both, or by the discovery and application of new methods of mining or metallurgy at a cost materially less than the commercial value of the deposit thus proven or created. The estimation of the value of the deposit must be made as of a date not later than thirty days after the commercial value of the deposit has thus been proven.

(2) Further ore discovered either by further development or exploration whether this ore be an extension of a previously known ore body or a new orebody or by improved processes of treatment, and not included within the previously estimated value or estimated life of the mine may be valued for depletion purposes following such discovery or discoveries.

Respectfully submitted,  
CORNELIUS F. KELLEY, *Chairman*,  
PAUL ARMITAGE, *Secretary*.

**AMENDED REPORT OF NOMINATING COMMITTEE**

The Committee on Nominations begs to submit the following as its nominees for the respective offices indicated, for the year beginning February, 1920.

*For President and Director:* HERBERT HOOVER.....Palo Alto, Calif.

*For Vice-President and Director:*

FREDERICK LAIST, Anaconda, Mont.....District 5

SEELEY W. MUDD, Los Angeles, Calif.....District 6

*For Directors:* W. M. CORSE, Mansfield, Ohio.....District 3

A. S. DWIGHT, New York, N. Y.....District 0

R. M. CATLIN, Franklin Furnace, N. J.....District 1

G. H. CLEVINGER, Washington, D. C.....District 9

W. A. CARLYLE, Ottawa, Can.....District 11

POPE YEATMAN, *Chairman*,  
Committee on Nominations.

**NATIONAL, STATE, AND LOCAL ACTIVITIES  
OF ENGINEERS**

Between two and three years ago, in response to an unmistakable and insistent demand, the four Founder Societies appointed Committees on "Aims and Organization," or on "Development," charged with reporting on the internal organization and the external (non-professional) activities of the engineers societies and to advise as to coöperations and coördination.

Each of these committees formulated a report, recognizing that efficiency in external activities could only be attained by intimate coöperation between the four Societies. As a consequence, each of the Founder Societies was requested to appoint members of a Joint Conference Committee, charged with discussing the situation and evolving if possible a plan of coöperation in external activities which would coördinate not only the efforts of the four Founder Societies but also other national technical and scientific societies, as well as local engineering and professional associations, groups or clubs.

The Joint Conference Committee entered on its task with enthusiasm, and after great labor evolved the outline and many of the details of a plan for engineering coöperation in public and inter-society activities. This report has now been submitted to the Boards of the Four Founder Societies, and has been ordered printed by our Board for the information of our members.

The question each member should put to himself is: "Is there not great need for such coöperation as is here provided for, and is not this a well-reasoned and practicable plan?" It may be admitted at once that it is not perfect, but it represents the best efforts of coöperative discussion of the four committees. Does it come near to meeting the need that exists? Can anyone improve it materially? If so, let the Board of our Institute have your assistance; write it a helpful letter of advice. It should be acted on at our Annual Meeting in February.

JOSEPH W. RICHARDS.

## REPORT OF THE JOINT CONFERENCE COMMITTEE

REPRESENTING THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, THE AMERICAN SOCIETY OF CIVIL ENGINEERS, THE AMERICAN SOCIETY OF TECHNICAL ENGINEERS, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

An informal meeting of the Conferees of the Development Committees of the four Societies was held in New York on July 2, 1919, at which the scope of the work was considered, and a sub-committee on Procedure, consisting of the chairmen of the Conferees from each of the four Societies, was appointed to arrange the program for and the time and place of the first formal meeting. The Conference subsequently adopted the name, "The Joint Conference Committee."

The Joint Conference Committee convened at the Hotel Montclair, Montclair, N. J., Aug. 13, 14, and 15, and in New York, Sept. 15, 16, and 17, 1919.

The Committee has divided its report into two parts, that covering the public activities and that covering the society activities of common interest to the four Societies.

### COÖPERATION IN PUBLIC ACTIVITIES

It was the unanimous opinion of those present at all conferences that one of the most important matters on which joint action can be taken is the formation of a single comprehensive organization to secure united action of the engineering and allied technical professions in matters of common interest to them.

In presenting its report upon a proposed form of organization which shall provide a voice to speak for the ideals of the profession, a hand to enforce unity of action and render the maximum of national, social and political service, the Committee presents for consideration the following plan. The Committee emphasizes that the plan can only be valuable and enduring as the motive dominating it is patriotic, broad-visioned and unselfish, but firmly believes that all efforts toward bringing a united profession to the service of the nation, the state, and the city will bring to its members the public honor, esteem and recognition which their qualifications deserve, now relatively unacknowledged and uncompensated.

In preparing this plan the Committee has recognized that there exists in Engineering Council a tool which is engraving an honorable record on the pages of professional history, but its limitations are well known and its poverty is chronic. If desired, Engineering Council can be molded into this organization by making it more democratic and founding it on direct representation of all engineers, rather than appointment as at present.

The great object is to provide an effective body, widely and truly representative, modestly yet adequately financed, which will be neither autocratic nor aristocratic, which will at all times stand as the representative and defender of the profession in matters affecting its honor, welfare and common interest.

The mandate for a vehicle to provide for coöperation and solidarity among engineers has been unmistakably expressed by the membership of the four Societies, through their several Development Committees. In obedience thereto the Joint Conference Committee has constructed a plan for an organization designed to perform this function by providing an opportunity to use the strength of every existing technical organization in the country, but without taking from them any of their present privileges, or in any way interfering with their respective spheres of usefulness.

Every new activity, to be effective, means work and needs money. A movement such as proposed, if undertaken without sufficient funds, would not only prove barren

of results, but by failure would bring ridicule upon the profession. In advance of its organization no definite budget can be prepared. The revenues proposed are moderate, and are based on the experience of Engineering Council, which, while called upon to occupy an ever-widening field, has been continually handicapped by limited resources.

In submitting the proposed fundamentals to govern a single comprehensive organization by which the engineering and allied technical professions may become more active in their service to the public and themselves, the Joint Conference Committee would point out the following as among some of the objects to be attained by such an organization:

1. To render the maximum of service to the nation through unity of action.
2. To give the engineers of the country a more potent voice in public affairs.
3. To secure greater recognition of the services of the engineer, and to provide for his advancement.
4. To promote *esprit de corps* among the members of the profession.
5. To provide the machinery for prompt and united action on matters affecting the profession, among which are: licensing and registration of engineers; National Service Committee; National Department of Public Works; conservation of national resources; publicity; classification and compensation of engineers; general employment bureau; engineering education; international affiliation of engineers; industrial relations.

In the greater vision resulting from the world war, it is apparent that no one alone can successfully solve the problems with which he is confronted. He needs the coöperation of his fellows. National problems demand united effort. The Joint Conference Committee believes that the greatest value of the proposed organization is in the united effort for the service of the nation, from which effort will result the greatest service to the individual.

The general plan offers a definite method of organization for public service. The Committee presents a means whereby the expressed wish of engineers throughout the land may be formulated in organization which shall make for the common weal.

The Committee submits the plan with the confident belief that it will be accepted by the four Societies, that they will make the sacrifices necessary and assume the responsibility of leadership, supporting the movement by virtue of their position in the engineering profession. A national movement by local societies is sure to come. The four National Societies can take the initiative and continue their leadership in American engineering by prompt action, or by inaction lose the prestige they now hold.

## ORGANIZATION AND PURPOSE OF A NATIONAL ENGINEERING FORCE<sup>1</sup>

In order that the engineering and allied technical professions may become a more active national force in economic, industrial, and civic affairs, and in order that united action may be facilitated, it is desirable that there be coöperation through a single comprehensive organization. The purpose of such organization should be to further the public welfare wherever technical knowledge and training are involved, and to consider all matters of common concern to these professions. It should embrace:

### COMPONENT PARTS OF ORGANIZATION

Local Affiliations, preferably under the auspices of local engineering societies or clubs, as follows: (a) "Local Associations" or "Sections" of the national engineering or technical societies; (b) local engineering societies; and (c) other local engineers and members of allied technical professions and associates.

A National Council, consisting of representatives of national engineering and technical societies and of representatives of local, state or regional affiliations or organizations.

The formation of State Councils, composed of representatives of the local affiliations within the state or otherwise representative of the majority of the engineers and members of allied technical professions in the state, is desirable as conducive to coöperation and to further the objects of the National Council, with which such

<sup>1</sup> The Joint Conference Committee does not deem it desirable to select definite names for either the organization or its component parts, but believes that this should be left to the action of this organization when formed.

State Councils should harmonize; and such State Councils are recommended wherever and whenever the local conditions warrant.

#### DELIMITATION OF AUTHORITY

Local Affiliations, State Councils (where formed) and the National Council, shall take action on local, state, and national matters, respectively, and they shall be autonomous with respect thereto. It shall, however, be the duty of the National Council to interest itself in the activities of Local Affiliations and State Councils if such activities are of national scope or affect the interest of the engineering and allied technical professions in other parts of the country; provided, that nothing herein stated shall be construed as preventing the discussion by any Local Affiliation or State Council or by the National Council of any matters of interest to engineers and members of allied technical professions.

#### PURPOSE OF LOCAL AFFILIATIONS

Local Affiliations are created to consider local matters of public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that united action may be made possible in local matters.

Each Local Affiliation shall submit its constitution and by-laws and all subsequent modifications thereof to the Executive Board of the National Council for approval.

#### PURPOSE OF STATE AND NATIONAL COUNCILS

State Councils may be created to consider state matters of public welfare with which the engineering and allied technical professions are concerned, as well as other matters of common interest to these professions, in order that united action may be made possible in state affairs.

Each State Council shall submit its constitution and by-laws and all subsequent modifications thereof to the Executive Board of the National Council for approval.

The National Council is created to consider national matters of public welfare with which the engineering and allied technical professions are concerned as well as other matters of common interest to these professions, in order that united action may be possible in matters of national scope.

#### BASIS OF REPRESENTATION

Each local, state, or regional affiliation or organization whose membership is not otherwise represented than through the national engineering or technical societies, shall be entitled to one representative to the National Council for a membership of from 100 to 1000 inclusive, and one additional representative for every additional 1000 members or major fraction thereof.

Each national engineering or technical society shall be entitled to one representative for a membership of from 200 to 2000 inclusive, and an additional representative for every additional 2000 members or major fraction thereof.

#### MEETINGS, DELEGATES, AND OFFICERS

The National Council shall hold a stated annual or biennial meeting. Other meetings may be called by the Executive Board upon its own initiative, and shall be called by it upon the written request of 25 delegates to the National Council, provided that all notices of special meetings shall be mailed not less than 60 days prior to the date thereof.

Delegates shall serve for terms of 4 years; provided that arrangements shall be made by the Executive Board so that an approximately equal number of delegates will be elected each year as provided in the by-laws.

The National Council shall maintain National Headquarters with a permanent Secretary appointed by and holding office during the pleasure of the Executive Board. He shall not be a member of the Executive Board.

The following officers shall be elected by the National Council: A President to hold office for 2 years, who shall be ineligible for immediate re-election; two Vice-presidents to hold office for 4 years, one to be elected every 2 years, and a Treasurer to hold office for 2 years.

#### THE EXECUTIVE BOARD

There shall be an Executive Board which shall direct the activities of the National Council in accordance with its adopted policies. It shall have such other functions as may be assigned to it by the National Council.

The Executive Board shall consist of the four officers elected by the National Council and one representative for each national society of 2000 members or less, with one additional representative from each national society for every 2000 members or major fraction thereof, to be selected from the membership of the National Council in each case by the national society concerned, and of a number of representatives selected from the membership of the National Council by the representatives therein of the local, state or regional affiliations or organizations, the said number to bear the same ratio to the representation of the national societies as the total membership of the local, state, or regional affiliations or organizations bears to that of the national societies; provided that the numerical basis of representation shall be so changed from time to time that the membership of the Executive Board shall not exceed thirty (30).

The President and Secretary of the National Council shall be the Chairman and Secretary, respectively, of the Executive Board.

#### ELECTORAL DISTRICTS AND ADMISSION TO NATIONAL COUNCIL

The National Council shall divide the country into such districts or regions, as may be desirable to provide for the election of the district members of the Executive Board. In establishing these districts due regard shall be had to geographical conditions and membership.

Any national engineering or technical society or any local, state or regional affiliation or organization desiring representation on the National Council shall submit a written request to the Secretary of the National Council which shall be accompanied by such data regarding the aims and status of the organization as the by-laws may provide.

The Secretary shall refer this request to the Executive Board, which shall submit it to the delegates, together with its recommendations, for a letter ballot.

The applicant shall be admitted by a majority vote of the National Council, provided that not more than 25 per cent. thereof shall vote in the negative.

Vacancies in the offices of President, Vice-presidents, Treasurer and in the Executive Board and delegates shall be filled as soon as feasible, by the agencies originally selecting the incumbents. Officers and delegates thus chosen shall serve for the unexpired terms.

#### FINANCES

For the purpose of financing the National Council and its Executive Board (not for the use of local affiliations and State Councils) the following assessments shall be made:

Each national society represented on the National Council shall contribute annually one dollar and fifty cents (\$1.50) per member.

Each local, state or regional affiliation or organization represented on the National Council shall contribute annually one dollar (\$1.00) per member.

#### COÖPERATION IN SOCIETY ACTIVITIES

Careful consideration was given to many points of common interest, and in the time available the Committee feels warranted in taking unanimous action on some of these topics, as follows:

##### COÖPERATION IN PROFESSIONAL ACTIVITIES

The Committee recommends that the growing coöperation in the activities of the Societies be fostered. The unified operation of the libraries, the organization of Engineering Council, American Engineering Standards Committee, Engineering Foundation, and Employment Service are conspicuous examples of such common action. Joint committees for definite purposes should be established, and standing or other committees directing similar activities in the several societies would profit by conference. In this way common action may be taken or similar policies may be adopted when advantageous, thus avoiding duplication of effort. Comprehensive means should be provided for united action in other larger professional and technical matters.

## JOINT MEETINGS

The Committee is of the opinion that periodic joint meetings of the four National Societies in various localities would be beneficial in the development of social intercourse between the members and for debating matters of common interest. Furthermore such large conferences would bring the engineer forcibly to the attention of the general public.

## INDUSTRIAL RELATIONS

The question of industrial relations is one of the most pressing issues of the present day. It is a vital factor in the economic future of the country. It is a matter with which the engineer is peculiarly fitted to deal. In view of the great importance of the subject, and of the unique relation of the engineer to industry, the Joint Conference Committee recommends that industrial relations should be a major subject for the consideration of the engineering and allied technical professions. It is also recommended that support be given to educational movements, such as the Industrial Service of the Y. M. C. A. in colleges, the Americanization movement, and similar activities.

## PERSONAL SERVICE BUREAUS

It is recommended that the Engineering Societies Employment Bureau be extended by providing for coöperation with the existing organizations of engineers maintaining employment service, and that upon the formation of the contemplated national organization the service be made available to the members of all constituent associations and branch agencies be established in communities where the local engineers desire to coöperate.

## STUDENT ORGANIZATIONS

The Committee recommends that it be the duty of local associations and sections of the National Societies to promote and assist general student engineering societies in neighboring universities and technical schools, to provide carefully selected speakers, and to maintain personal contact with such societies. In view of the desirability of more intimate coöperation among engineers, consideration of the affiliation of the student branches of the national Societies into general student engineering associations is recommended.

## THE AMERICAN ENGINEER IN FOREIGN SERVICE

It is the opinion of the Committee that American engineers in foreign countries should be urged to assemble for purposes of better acquaintance and mutual help, and to fraternize with the engineers of the country in which they reside, for the promotion of world-wide coöperation.

## STANDARDS

The Committee is unanimously of the opinion that the correlation of standards by the four Societies and others working with them, along the lines contemplated by the American Engineering Standards Committee, should be approved in principle; but in view of the fact that this matter is under consideration by the Boards of Direction of those Societies and the matter is well advanced, this Committee does not feel warranted in making a further recommendation.

## ARBITRATION AND EXPERT TESTIMONY

The Committee is of the opinion that the recommendation of the Committee on Development of the American Society of Civil Engineers in regard to arbitration and expert testimony, namely, that a committee of the American Bar Association be asked to coöperate with a joint committee of the four Societies in order to develop better practice in these matters, should be referred to Engineering Council.

## LICENSING AND REGISTRATION OF ENGINEERS

The Committee of Engineering Council that has had under consideration the licensing and registration of engineers has nearly completed its draft of a standard form for a uniform law on these matters. Since it is undesirable to duplicate this work, the Joint Conference Committee recommends that action be deferred pending the receipt of that report.

## PATENT LAW

Since the Patents Committee of Engineering Council, after due consideration, has approved the report of the Patents Committee of the National Research Council, in which definite recommendations are made in regard to the present patent system, it is deemed inexpedient for the Joint Conference Committee to take action on the subject of Patents and the Patent Law.

## CODE OF ETHICS

The Joint Conference Committee, after discussion of the question of a code of ethics, reached the conclusion that the matter would require extensive study and careful consideration in order to secure joint action by the representatives of the four Societies, and therefore deemed it unwise to attempt to make a report on this matter at this time.

## CONCLUSIONS

The Joint Conference Committee was confronted with a multiplicity of matters inviting consideration, but in the two and one-half months of its existence it has been able to consider only the more important ones. The vital matter is the general organization of engineers for public activities, a general plan for which is now submitted for the approval of the Societies.

When the four Societies shall have approved the plan, the Committee holds itself in readiness to work out the details by which it may be put into effect. The Committee has therefore adjourned to meet after this matter has been considered by the four Societies.

ARTHUR S. DWIGHT  
PHILIP N. MOORE  
JOHN V. W. REYNDERS,

*Chairman*

Conferees of the Committee on Development, The American Institute of Mining and Metallurgical Engineers

GEORGE G. ANDERSON  
GARDNER S. WILLIAMS  
RICHARD L. HUMPHREY

*Chairman*

Conferees of the Committee on Development, The American Society of Civil Engineers.

EDWIN S. CARMAN  
DEXTER S. KIMBALL  
LOUIS C. MARBURG

*Chairman*

Conferees of the Committee on Aims and Organization, The American Society of Mechanical Engineers.

LEWIS T. ROBINSON  
CHARLES F. SCOTT  
CALVERT TOWNSLEY

*Chairman*

Conferees of the Committee on Development, The American Institute of Electrical Engineers.

NOTE.—In addition to the above, the following members have been in attendance at meetings of the Committee, but were unable to participate in the final drafting of the report: Joseph W. Richards and Allen H. Rogers, The American Institute of Mining and Metallurgical Engineers and Charles E. Lord, The American Society of Mechanical Engineers. There was also present by invitation Comfort A. Adams of Engineering Council.

The War Department announces that many applications for information from official records of the Department are made through attorneys. Employment of attorney is unnecessary for this purpose. Applications for information from official records may be addressed by the person directly interested to the Adjutant General of the Army, who will furnish the information to applicant direct, provided it can properly be furnished.

## SIMPLIFIED SPELLING FOISTED UPON US

### WHAT NEXT?

A small group of members of the Institute headed by W. H. Shockley, has insistently demanded that the Institute submit to the members for letter ballot the question of our using in our publications and correspondence certain so-called "simplified spellings." The principal argument in favor of this proposal is written by Mr. Shockley and will be submitted in full to the membership for ballot. It rests chiefly on the desirability of saving the time of school children in the learning of the spelling of the English language.

A sample of correspondence had with one of the gentlemen on this subject is given herewith in order that members may see what the correspondence and publications of the Institute would look like if we adopted the proposals. This sample was chosen at random:

"Onse I condemd the report ov a president of the Institute. He did not pruve his case even on paper—"a hot air profet," I sed. Time has pruvd he was."

"I rote yu about the muvement tu better the spelling in the Institute Bulletin, etc., neglecting to say some things that I mite hav said and things hav happened since which no member ov a democratically governed society shoud stand without protest."

The members are asked to understand that this is no joke, but is a serious propaganda forced upon us by the members who base their claim on Section 4 of Article IV of the Constitution that any matter that is advocated by 25 members of the Institute must be put to vote.

The argument against the adoption of the spellings prepared by the President and Directors of the Institute urges that the Institute's particular purpose is the development of mining and metallurgy; that our publications are for men and not for children, and that the dues of the members should not be spent in wasteful balloting on any unrelated subjects, nor the time of the Officers and Directors in propaganda outside of the Institute's field.

Do not neglect to vote on this subject when your ballot arrives in an early mail.

## EXPOSITION OF MINING MACHINERY

A permanent exhibition of mining machinery has just been opened in the Grand Central Palace, New York City. The exhibits include: Aerial tramways, amalgamation, assaying and laboratory appliances and supplies, blast furnaces, coal, coal-breaker plant, coal excavation, coal products, compressed-air plant, concentrating, crushing, cyanidation, distillation, drainage and pumping, drilling, earth excavation, electrical supplies, explosives, fire prevention, flotation, general supplies, hoisting, hygiene, welfare, iron products, leaching, mechanical conveyors, metal products, natural gas, petroleum, petroleum products, electric, steam, hydraulic, gas, air, and internal-combustion engines, power machinery, preparation of coal, pumping, refining, roasting, rock excavation, rotary drilling, boring, safety appliance, screening and washing, sizing and classifying, smelting, storage of coal, storage of petroleum, surface transportation, surveying, underground timbering, underground transport, ventilation, mine.

This exposition is operated by the Merchants and Manufacturers Exchange of New York for the purpose of showing under one roof all lines of machinery and mechanical appliances. As far as possible, the exhibits will be shown in operation.

The Advisory Committee is as follows:

*General.*—Howard R. Ward and H. C. Parmelee.

*Coal and Coke.*—Prof. H. H. Stoeck, Samuel A. Taylor, Edwin Ludlow.

*Petroleum and Gas.*—Frederick G. Clapp, Ralph Arnold.

*Extraction of Metals.*—Charles W. Merrill, E. Gybbon Spilsbury.

*Refractories.*—Kenneth Seaver.

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## UTILIZATION OF CULM

In a letter to Prof. L. P. Breckenridge, chairman, urging the continuation of the Fuel Conservation Committee of the Engineering Council, Edwin Ludlow calls attention to the millions of tons of culm in the anthracite region that can be utilized in properly equipped plants and the electricity generated transmitted to New York, Philadelphia, and other nearby cities. He says:

"Experiments have shown the economic value of No. 4 Buckwheat, which passes through a  $\frac{1}{16}$ -in. mesh and over a  $\frac{1}{32}$ -in. mesh. Culm passing through a  $\frac{1}{32}$ -in. mesh is pulverized until it passes through a 300 mesh and is then burned under boilers. Two plants of this kind are now in successful operation in the anthracite region. Another rather interesting experiment was using 30 per cent. of this pulverized coal with 70 per cent. of oil in the generation of steam in the place of pure oil. This utilization of the fine anthracite, which has always been a waste product and thrown away, is not only fuel conservation in its truest sense but in the case of a bituminous strike, when no strike is contemplated in the anthracite field, will furnish fuel to manufacturing plants that otherwise would be obliged to shut down."

## OFFICERS OF AFFILIATED STUDENT SOCIETIES

All the Affiliated Student Societies report that the present college year promises to be a most successful one. The officers for this year, so far as reported, are as follows:

## TUFTS COLLEGE CHEMICAL SOCIETY

*President*, CHESTER B. PIERCE      *Vice-president*, JOHN H. SCHMUCK  
*Secretary-treasurer*, DANIEL A. PRESCOTT

## MICHIGAN COLLEGE OF MINES

*President*, R. G. SATTERLEY      *Third vice-president*, H. E. BLAKE  
*First vice-president*, LESTER VOCKE      *Secretary*, J. E. FLANIGAN  
*Second vice-president*, W. J. KLINE      *Treasurer*, PROF. JAMES FISHER, JR

About 75 per cent. of the students are ex-service men, and most of them saw service in France.

## MISSOURI MINING AND METALLURGICAL ASSOCIATION

*President*, F. W. UTHOFF      *Secretary-treasurer*, W. F. NETZEBAND.

## OHIO STATE UNIVERSITY

*President*, I. D. SEALRIGHT      *Secretary*, C. M. CHAFFEE, JR.  
*Vice-president*, I. F. FRANCIS      *Treasurer*, J. W. KERR

## THE MINNESOTA SCHOOL OF MINES SOCIETY

*President*, J. D. WHEELER      *Secretary-treasurer*, G. R. BUTLER  
*Vice-president*, L. E. ARNOLD, JR.      *Editor of Bulletin*, E. N. CARLSON  
*Assistant Editor of Bulletin*, HOWARD C. HALL.

## GEOLOGY CLUB UNIVERSITY OF KANSAS

*President*, PAUL A. HOLLAND      *Vice-president*, RAY WALTERS  
*Secretary*, HUBERT D. COX.

## THE PICK AND HAMMER CLUB, THE UNIVERSITY OF OKLAHOMA

*President*, WALLACE THOMPSON      *Vice-president*, MILO ORR  
*Secretary-treasurer*, VITA LEE WATERS

## VOLUMES 51, 52 AND 53 WANTED

The Institute's edition of Volumes 51, 52 and 53 has been exhausted. We have a number of requests for these volumes which we are under the circumstances unable to fill. We shall be glad to purchase these volumes, if in good condition, at the rate of \$4. each for morocco bindings and \$3 for paper bindings.

## COPIES OF HOOVER DINNER SPEECH

There was such a large demand for copies of the speech of Herbert Hoover at the A. I. M. E. dinner given in his honor on Sept. 16, that a special edition has been run off; anyone desiring copies may obtain them by applying at the office of the Secretary.

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## EIGHT YEARS WORK FOR GERMANS IN FRENCH MINES

According to *Vorwärts*, the German Mining Commission sent to ascertain the damage done to the mines of France says that the work of restoring these mines will furnish work for all the unemployed in Germany for the next 8 years.

The commission said the work of reconstruction would have to be done from "the ground up," especially in the Departments of Pas de Calias, Courriere, Lens, Lievin, Drocourt, Mourchin, Carvin, and Dourgas, where the destruction was pronounced "terrible." Most of the mines have been "drowned," and in rebuilding new shafts would have to be protected against the inward pressure of water.

The Germans declared the work of restoration would not only be one of great difficulty, but that in many cases it was impossible to ascertain the extent of the damage done to each mine. They also said it was not easy to fix responsibility for the destruction because it was done by numerous groups of troops and the records showing where each military unit was located and at what period were not complete or available.

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## RESOURCES OF TENNESSEE

*Resources of Tennessee*, the quarterly magazine issued since 1910, by the State Geological Survey of Tennessee has been discontinued. The reports on the resources of the state (mineral, waterpower, etc.) will appear from time to time in bulletin form. There are several such bulletins in preparation at the present time.

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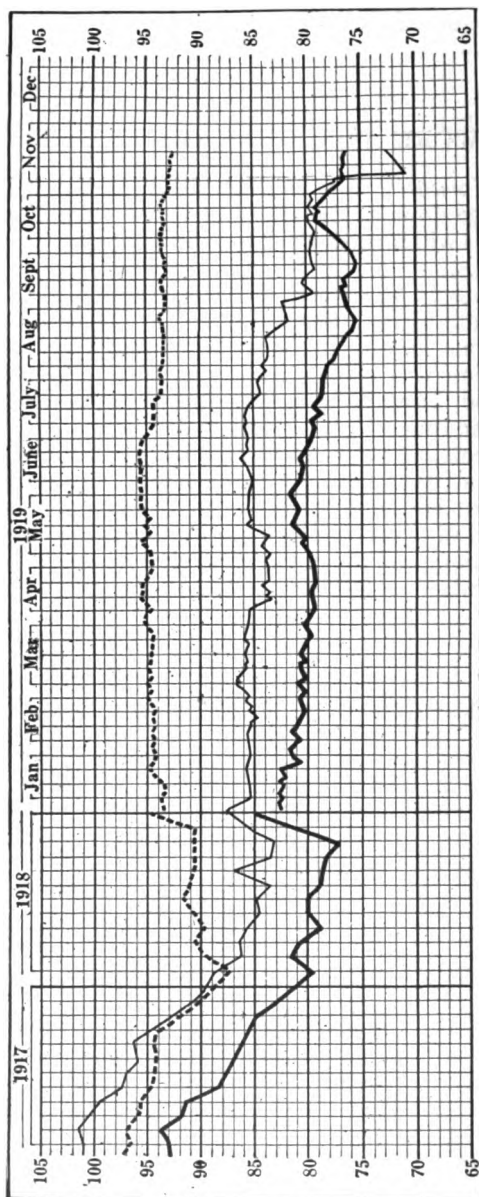
## NATIONAL INDUSTRIAL CONFERENCE

The first National Industrial Conference was disbanded without accomplishing the results hoped for. A second conference is to be called in the near future. In response to suggestions of members of the Founder Societies, the following telegram was sent, Oct. 29, to the President and each member of his cabinet.

"Engineering Council respectfully recommends appointing on new Industrial Conference two or more engineers familiar with industrial problems. Council represents five national societies of professional engineers having forty-one thousand members. Washington office in McLachlen Building."

## TREND OF BOND AND STOCK MARKETS

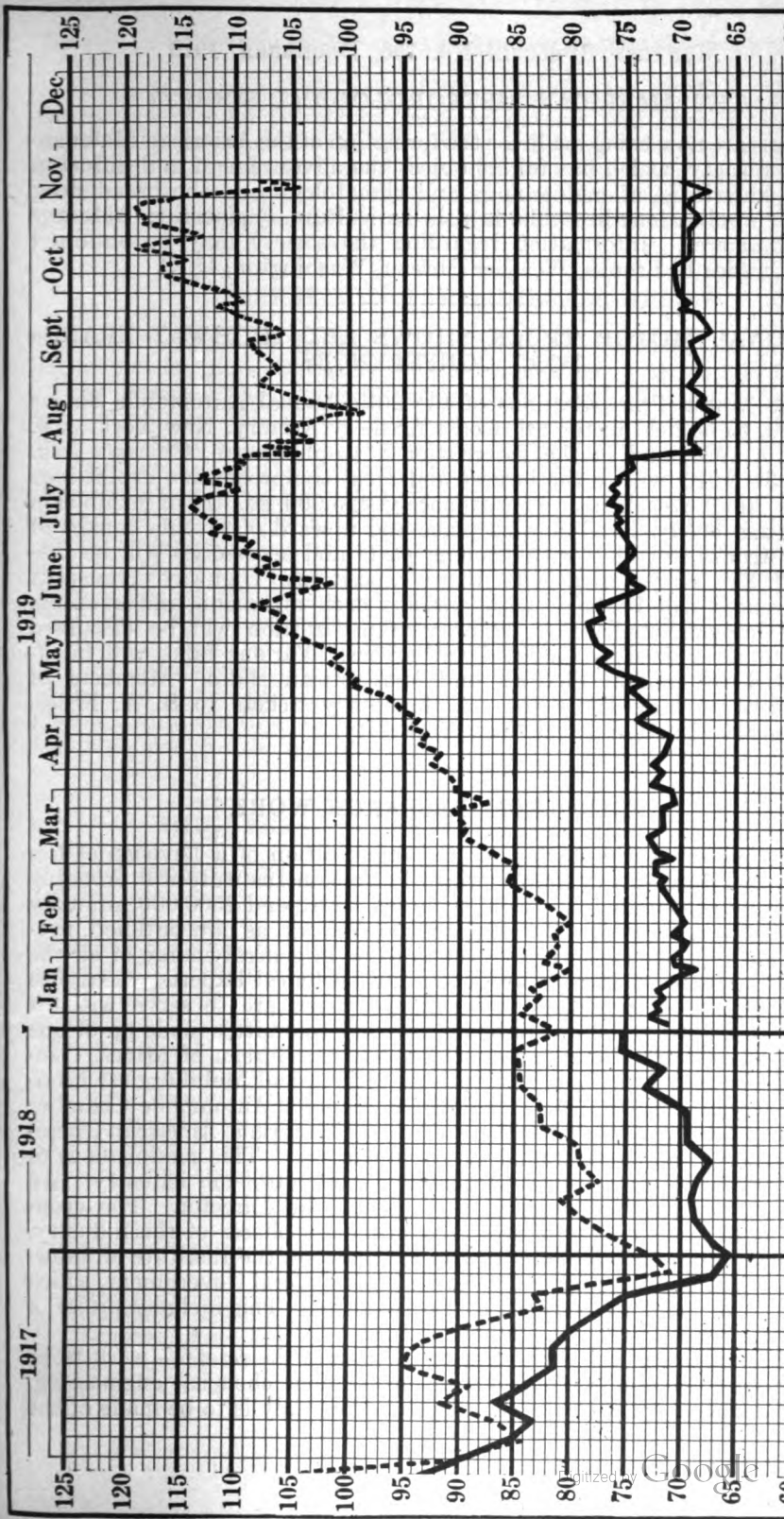
For the benefit of those of our members who are considerable holders of securities, but owing to their isolated situations are not in close touch with the metropolitan market and current quotations, we are publishing



PRICE TREND OF NEW YORK BOND MARKET

This graph shows the average prices of ten railroad, ten industrial and five public utility bonds on the first business day of each month from January, 1917, to December, 1918, and the weekly fluctuations since January 1, 1919.

two very interesting graphs, showing the course of the bond and stock markets in New York over a long period. These graphs are furnished through the courtesy of the financial department of the New York Tribune.



## THE AMERICAN METEOROLOGICAL SOCIETY

Plans are now being made for the formation of the American Meteorological Society, which has for its object the advancement and diffusion of the knowledge of meteorology and climatology and the broadening of their applications in public health, agriculture, engineering, industry and commerce. Information regarding the society may be obtained from Charles F. Brooks, Weather Bureau, Washington, D. C.

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## NATIONAL MOTOR TRUCK SHOWS AND HIGHWAY TRANSPORT CONFERENCES

The Motor Truck Sections of the 20th Annual Automobile Shows of 1920, to be held in the 8th Coast Artillery Armory, New York, Jan. 3 to 10, 1920, and in the International Amphitheatre, Chicago, Jan. 24 to 31, 1920, will be the largest and most comprehensive exhibitions of the kind ever held. Approximately 125,000 sq. ft. of exhibition space has been allotted at each place and upward of seventy makes of motor trucks, together with trailers, parts and accessories will be displayed. In conjunction with these expositions, Highway Transport Conferences will be held, with sessions each afternoon and evening. Every important phase of highway transportation will be discussed by men recognized as qualified authorities. Various talks will be illustrated by motion pictures and stereoptican slides. Members of the Institute may apply for complimentary tickets to S. A. Miles, Manager, 7 East 42d Street, New York City.

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## PETROLEUM RESEARCH WORK

The plan recently started for the organization of a Division of Research and Statistics in the American Petroleum Institute will probably shortly be consummated. It is proposed to expend \$500,000 annually for this research work. The organization's work, as now outlined, provides for a Technical Director, who is to be in general charge of all the work. He is to be assisted by Consulting Technical Experts, who are to be distinguished specialists in the industry and are to serve without pay. In addition, there is to be an advisory committee made up of one representative from the Bureau of Standards, Bureau of Mines, Geological Survey, American Institute of Mining and Metallurgical Engineers, Society of Automotive Engineers, National Automobile Chamber of Commerce, American Society for Testing Materials, American Chemical Society, and the National Research Council. This committee is to meet regularly to discuss the problems of the petroleum industry. An engineer and chief economist are to assist the Director. The economist is to be in charge of statistics, economic phases of the industry, and publicity. It is the intention to centralize in the Institute all information that may be required by the States or Federal Government, which would be of value to members of the Institute. This includes prices of crude oil, refined products, and natural gas.

The engineer of the division is to coördinate the research work to be undertaken by the subdivisions of production, chemical engineering, utilization, and special research. Systematic study is to be made of the

questions of leasing and bonuses, drilling, pipe lines, storage, and tank cars. Many new uses for petroleum products, patents, and other special problems are to be studied. The economist will study international policies affecting the petroleum industry and for this purpose agents are to be stationed in important foreign commercial centers. Uniform cost accounting and uniform laws and regulations are to be sought.

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### LIBERALIZED WAR MINERALS RELIEF

Activity with the legislation proposing to liberalize War Minerals Relief Act has now started before the Committee on Mines and Mining of the House. They are considering House Joint Resolution No. 170, which brings out the fact that war minerals claims in excess of \$15,000,000 had been filed but that a considerable portion of the claims are being denied because of the Attorney General's interpretation of the Act. The resolution states that it was the intention of Congress in passing the War Minerals Relief Act "that all producers of the minerals mentioned should be repaid such sums as they are in equity and good faith entitled." The Attorney General's opinion is that the request or demand must have been made on the claimant direct. The resolution provides that all claimants "who in response to any personal, written or published request or demand from any of the Government agencies mentioned in said Act in good faith expended money in producing or preparing to produce any of the ores or minerals named therein \* \* \* and have heretofore filed their claims within the time and in the manner prescribed in said Act" are to be reimbursed for the net losses incurred.

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### ENGINEERS IN THE UNITED STATES CENSUS

As a result of Engineering Council's request to the Director of the Census, the National Service Committee has been successful in effecting a reclassification of engineers so that all technical men will be listed as such and they will be separate and distinct from the non-technical engineers. Thus, the next census will bring an enumeration of all technical engineers together as one unit under the main headings of civil, mechanical, electrical and mining; architects also will be enumerated separately. This will enable the engineering profession, the Government or any other interested organization to know exactly how many technical men there are in the United States and in each state. The enumeration will also include non-technical engineers, except that there will be no such heading and in order to get the totals of non-technical men all of the various grades of this classification would have to be sorted out and added.

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### NEW PUBLICATIONS OF THE U. S. GEOLOGICAL SURVEY

Professional Paper 112. Upper Cretaceous Floras of the Eastern Gulf Region in Tennessee, Mississippi, Alabama, and Georgia, by E. W. Berry. 177 pages, 33 plates, 12 text figures.

Professional Paper 113. Iron-depositing Bacteria and Their Geologic Relations, by E. C. Harder, 89 pages, 12 plates, 14 text figures.

- Bulletin 691. Contributions to Economic Geology (Short Papers and Preliminary Reports), 1918. Part II. Mineral Fuels. David White, G. H. Ashley, and M. R. Campbell, geologists in charge. 361 pages, 44 plates, 45 text figures. Contains 14 papers by 13 authors.
- Bulletin 692-E. Sulphur Deposits and Beach Placers of Southwestern Alaska, papers by A. G. Maddren. 39 pages, 2 plates, 6 text figures.
- Water Supply Paper 429. Ground Water in the San Jacinto and Temecula Basins, Calif., by G. A. Waring. 113 pages, 14 plates, 15 text figures.
- Mineral Resources of the United States, 1916. Part II, Nonmetals; E. F. Burchard and G. F. Loughlin, geologists in charge. 1120 pages, 4 plates, 23 text figures.
- Preliminary Report on the Mineral Resources of the United States in 1918. Introduction by E. S. Bastin; statistics assembled by Martha B. Clark. 106 pages, 1 text figure.
- Professional Paper 120. Shorter contributions to general geology, 1918; David White, chief geologist. 1919. 208 pages, 37 plates, 19 text figures. Contains 9 papers by 10 authors.
- Bulletin 678. Clays and shales of Minnesota, by F. F. Grout, with contributions by E. K. Soper. 1919. 256 pages, 16 plates, 38 text figures.
- Bulletin 692-D. Mining and mineral deposits in the Cook Inlet-Susitna region, Alaska. Papers by S. R. Capps, J. B. Mertie, jr., and G. C. Martin. 1919. Pp. 177-282, Pls. IV-VI, figs. 3-6.
- Bulletin 692-F. Mining in Fairbanks, Ruby, Hot Springs, and Tolstoi districts, Alaska; Papers by Theodore Chapin and G. L. Harrington. 1919. Pp. 321-351, Pl. IX, figs. 13.
- Bulletin 692-G. Mineral Resources of Seward Peninsula, Alaska; Papers by G. L. Harrington. 1919. Pp. 353-400, Pl. X.
- Bulletin 711-B. Oil shale in western Montana, southeastern Idaho, and adjacent parts of Wyoming and Utah, by D. D. Condit. 1919. Pp. 15-40, Pl. III, figs. 2-3.

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A mail tunnel for New York city, as provided in the House bill, has undergone extensive hearings as result of which the old bill will be entirely discarded. The new bill will provide for investigation and report by a board of engineers before any plan is considered. This was the recommendation of National Service Committee, Engineering Council.

In an interview granted the Associated Press in Paris, Sept. 1, Herbert Hoover expressed the opinion that a distressing era of speculation in foodstuffs in the United States and throughout the world's primary food markets is largely responsible for high food costs.

Americanization work among foreign-born employees of Chicago industrial plants, conducted by Committee on Americanization of the Chicago Association of Commerce, in collaboration with Board of Education, has grown remarkably since it was started a year ago. More than 6000 students are attending 65 classes, which hold 156 sessions weekly in 30 different plants.

The Wall Street Journal states that because gold production decreased from \$79,192,164 in 1903, record year, to \$30,050,220 in 1917, Australian gold producers are asking for subsidy of \$5 an ounce on their output.

From the \$11,000,000 endowment fund to be raised this fall by alumni of Harvard University, \$2,500,000 are to be devoted to needs of the Harvard Medical School for intensive study of Spanish influenza and other diseases.

## BIOGRAPHICAL NOTICES

## FRANZ FOHR

On July 27, 1919, there passed away a simple, unassuming gentleman, who, throughout his life, allowed his intense modesty to keep himself in the background and during his later years effaced himself so thoroughly that but few of his acquaintances knew aught of him. Yet he was one of our accomplished metallurgists, who did good work in the practice of his profession and lived an upright life. Now that he is no longer with us Franz Fohr cannot plead to be overlooked, and those who fondly remember him will be gratified by his receiving his due.

Franz Fohr was born, Sept. 7, 1838, in Mannheim, Germany. Of his ancestry, education, and early career we know scarcely anything. We do not even know just when he came to America, or what led him hither. The first record of his professional work in this country, found among his papers, shows that from July, 1870, to Jan. 1, 1872, he was superintendent of the Newark Smelting & Refining Works, then owned by Edward Balbach & Son. At that time the Balbach works at Newark, established in 1850, and the Selby works at San Francisco, established about 1866, were the only important silver-lead refineries in the United States. Mr. Fohr may have been associated with the Balbachs for some time before he became superintendent of their plant or he may have come from Germany but a short time previously. At all events, it is certain that he was at that time an experienced and accomplished metallurgist. After leaving Newark and going to San Francisco, he soon formed a connection with Thomas H. Selby & Co. Early in 1874, this firm sent him to New York to procure information respecting the manufacture of white lead. His engagement in New York terminated on Jan. 31, 1875.

During 1875, Mr Fohr spent some time at Silver Islet and in the Lake Superior copper region, but of his work there no record remains. In the latter part of 1875, or early in 1876, he associated himself as metallurgist with the Boston Silver Co., operating at Saint John's, Summit County, in which William L. Candler, of Boston, was the moving spirit. That company was developing its mine in 1875. At the end of that year it "had about 800 tons of ore on hand, about three-fourths of which is dressing ore, to be concentrated in its very systematic establishment and to be smelted into pig lead." Evidently Mr. Fohr was engaged for the latter purpose. Henry A. Vezin, erudite and painstaking, was the mechanical engineer for the company. In the fall of 1876, Anton Eilers took his family for the first time so far West as Denver and Mr. Fohr went with them. I do not think that Mr. Eilers had any connection with the Boston Silver Co., save possibly in a consulting capacity, but he visited Saint John's and the enduring friendship among Eilers, Fohr, and Vezin, which terminated only with their deaths, dated from that time.

I ought to know more about the association at Saint John's, for only a few years later I was under the tutelage of the distinguished and lamented Vezin, who never tired of relating the history of that famous, if not very successful enterprise, and also I knew Mr. Fohr from 1886 onward, but memory is an evanescent thing. My recollection is that a lot of excellent engineering and metallurgical work was done there for which there was not any great foundation. At all events, Mr. Fohr remained with this company nearly 3 years and then took charge of the

smelting operations of the Horn Silver Mining Co. at Frisco, Utah, which he conducted from Aug. 1, 1878 to Aug. 1, 1879. This was the time of the height of the boom at Leadville, and it was but natural that Mr. Fohr moved promptly to the greatest silver-lead mining and smelting district. He became part owner in the Malta Smelting Co., below California Gulch, and had charge of its plant. In 1881, he became superintendent of the Harrison Reduction Works of the St. Louis Smelting and Refining Co. and retained that position until his retirement from active work. I do not remember just when his retirement took place, but my recollection is that it was during the '90s. He then moved to New York and kept a little office there, in company with Faber du Faur, one of his early friends. Mr. Fohr went religiously to his office every day, spending a few hours there, reading and absorbing the general information for which all his life he was so greedy.

On his 75th birthday, which he celebrated with the Eilers family at Sea Cliff, Mr. Fohr said that in early life he had made up his mind to divide his years of life, 25 years to study, 25 to accumulating money and 25 to enjoyment. He then remarked that having passed 75 years he was free to do anything he liked. I do not think that he conformed exactly to that schedule, but he was methodical enough in his habits to develop such a plan and follow it generally.

Mr. Fohr was a tireless student both in his professional work and outside of it. Indeed, with his calm philosophy he was able to dismiss the affairs of the works when he left them for the day. He had them so well organized that he felt no concern about them ever. I sat at the same table at mess with him for two years, perhaps, and do not recall his ever talking "shop." He preferred to talk about politics—in the broad sense—art, music, literature, and history. His knowledge was profound, his memory wonderfully accurate, and woe to anyone who challenged his statement of facts. So careful was he in discriminating between wheat and chaff that we used to say laughingly that he would not accept anything as being truly news of the day until he had the authority of the *London Times*, the weekly edition of which he read religiously.

In the latter portion of his life it had been his custom for many years to go to Sea Cliff every Sunday, spending the day alternately at the houses of Anton and of Karl. It was at the latter's that he died, July 27. He had reached a ripe old age and had outlived nearly all of his early associates of his own generation. Of that famous galaxy of metallurgists that created the art of silver-lead smelting in this country between 1870 and 1885, he was practically the last. The seniors of the present time do not hark back to the pioneering stage, but belong to the early part of the engineering stage which followed. Mr. Fohr's modesty and his disinclination to form a wide circle of friends prevented him from attaining the fame that might easily have been his if he had cared for it. Rather he chose to have only a few friends, but to them he was one of the closest and most loyal they ever had, and to their children he soon became and always remained "Uncle Fohr."

W. R. INGALLS.

#### WATARU WATANABE

Born in the City of Nagasaki in the year 1858, Wataru Watanabe went to Tokyo for study in his youth and took the mining and metallurgical course at the Tokyo Imperial University. After his graduation

in 1879 he was sent to Germany by his Government, where he entered the Universities of Freiberg and Kraustal. Later he spent some time in Belgium, England and America, studying the various methods for preventing explosions of coal gas and dust.

On his return to Japan, in 1884, he was appointed an instructor of the Imperial University and two years later was made full professor in the College of Engineering. In 1891 he was granted the degree of Kogakuhakushi (Doctor of Engineering) and in 1899, again visited Europe and America. In 1902, he succeeded Doctor Tatsuno as the Director of the Engineering College of the Tokyo Imperial University and remained in this office for 16 years, during which period he applied himself persistently to the study of ore-deposits and the education of engineers. He also filled many positions of honor and trust in addition to performing his duties with the University. While Chief of the Sado local bureau of the Imperial Household Department, he introduced various innovations and advanced technics of the West, such as stamp amalgamation mill of the Homestake type, Frue vanner's, water-jacket furnace, etc. thereby perfecting the most arduous work of refining poor ores and utilizing the slags. Also by increasing the manufacture of copper sulfate, he not only supplied the domestic needs but made its export possible.

He took the lead in introducing the system of savings banks and other welfare corporations for the benefit of the miners. He laid, also, the foundations of various institutions for protecting the miners and their families from diseases and accidents. He also established the Sado Mining School, of which he became the director.

At the time of the Russo-Japanese war, he was commissioned by the Katsura Cabinet to carry out the investigation and improvement of gold mines in Japan, which resulted in the most effective demonstration of national strength, assuring the people of the abundance of resources.

Doctor Watanabe was a devout follower of the late Rev. Unsho, the founder of the Buddhistic Institute in Mejiro, Tokyo. On the death of Unsho he planned, in company with Dr. Sawayanagi, the President of Japan's educational society, and others interested, to found a school for promoting moral and religious education in pursuance of the long cherished design of Unsho's, which plan, however, has regrettably not come to materialize on account of his untimely death, on the 29th of June, 1919.

In his life time he was decorated and presented with the Emperor's gifts and granted honors on several occasions which it is impossible to enumerate one by one. On Nov. 7, 1909, he was promoted to the Third Grade of Senior Rank (Shosammi) and decorated with the First Order of Merit in recognition of his services for the mining industry and the education of engineers. He was also granted, by Imperial Command, the Honorary Professorship of the Tokyo Imperial University. He became a life member of the American Institute of Mining Engineers in February, 1912, an appointment following the visit of the Institute party to his country.

He was survived by his wife, Sumi, three sons and five daughters. His eldest son, Jin, born in 1887, graduated from the Engineering College of the Imperial University in 1912, is a promising architect in the government service. Three of his daughters are married; the first, to Dr. Yokobori, director of the Akita Mining College, the second, to Dr. M.

Kamo, professor of the Tokyo Imperial University, the third, to Mr. M. Konda, architect and professor of the Tokyo Fine Art School.

M. OTAGAWA.

#### HENRY A. J. WILKENS

Henry A. J. Wilkens was born in Baltimore, Md., Dec. 18, 1867, the son of Henry and Therese Wilkens. He received his early education at the Friends School in that city and at the age of fifteen entered Lehigh University, graduating in 1887, one of the youngest men in his class. He then took a year's post-graduate work and received the degree of mining engineer. In September, 1888, he matriculated at The Royal Mining Academy, Freiberg, Saxony, as a special student, in his vacations taking practical courses at mines and smelters throughout Germany.

Returning to the United States in 1889, for a short period he was in the employ of the Empire Zinc Co. at Joplin, and was then engaged by St. Louis mining interests to take charge of a small mine in the mountains east of San Diego, California. The following summer he accepted the position of chemist for the Lehigh Zinc & Iron Co. at South Bethlehem, Pa. This was the beginning of a friendship and business association with August Heckscher and John Price Wetherill that continued for many years.

In the winter of 1894 and 1895, with the late H. B. C. Nitze, he entered the employ of the Geological Survey of North Carolina and, under the direction of Doctor Holmes, then state geologist, made a complete survey of the gold deposits of the Southern Appalachian Range extending from North Carolina to upper central Alabama. As a result of this work, he and Nitze wrote two articles, one, entitled "Gold Mining in North Carolina and Adjoining South Appalachian Regions" was published in the North Carolina Geological Survey Bulletin No. 10, the other "Present Condition of Gold Mining in the South Appalachian States" was published in vol. xxv of the Transactions of the American Institute of Mining Engineers. In collaboration with Nitze, he also wrote an article entitled "Magnetic Separation of Non-magnetic Material" which was published in vol. xxvi, of the Transactions of the American Institute of Mining Engineers.

In the latter part of 1895, he entered the employ of the Wetherill Concentrating Co. at South Bethlehem and for the following 2 years was engaged in work connected with the development and marketing of the Wetherill magnetic separator. Two years later, as the European representative of that company, he sold the world's rights to the Wetherill patents to interests connected with the Metallurgische Gesellschaft, Frankfurt, A/M, reserving, however, the right to use the process in treating the ores of the New Jersey Zinc Co. and its subsidiaries. Returning from Europe in the summer of 1897, he entered the employ of the New Jersey Zinc Co. and had general supervision over the operations of the Empire Zinc Co., a subsidiary of the New Jersey Zinc Co., in Missouri. He was also largely connected with the development of the Schroeder contact process for the manufacture of high-grade sulfuric acid, by means of which the first acid of this kind was manufactured in the United States. Later, all of the western operations of the New Jersey Zinc Co. were under his care.

On Mar. 1, 1908, he resigned his position with the New Jersey Co. and for 3 years practised as consulting mining engineer. During this

time he made an extensive trip through the west coast countries of South America. In December, 1911, he became president of the Mines Management Co. and during the next few years was instrumental in the rehabilitation of several of the old iron mines of New Jersey and Pennsylvania, notably the Mt. Hope and Washington mines of the Empire Steel & Iron Co. On Jan. 1, 1916, he resigned as president of this company and, with Walter B. Devereux, Jr., formed the consulting mining engineering firm of Wilkens & Devereux, of which he was the senior partner at the time of his death.

On Aug. 1, 1918, he married Miss Gertrude Wetherill, the daughter of William C. Wetherill, in Denver, Colo.

For the past 3 years he had not been well and was forced to undergo three major operations within a relatively short period. He never fully recovered from the shock and strain of these operations, which undoubtedly was responsible for the sudden weakening of the heart which culminated fatally at Pueblo, Colo., on the morning of Sept. 13.

He was a member of the Mining and Metallurgical Society of America, the American Institute of Mining and Metallurgical Engineers, and the following clubs and societies: Racquet and Tennis, City Midday Club and New York Athletic Club of New York, Rittenhouse Club of Philadelphia, University Club of Denver, Delta Phi Fraternity of Lehigh University, Lehigh Alumni Association and the Pohoqualine Fish Association. He was a close observer, student, and lover of nature and possessed an exhaustive knowledge of flora and fauna. His desire for companionship was so great that he always wished to be with friends and was never happy when alone. His love of children was remarkable. During the last years of his life he took an intense interest in a Fresh Air Home for little girls which he helped greatly in financial and other ways.

#### JOHN D. SANDERS

J. D. Sanders was born in Livermore, Maine, in 1851 and graduated from the University of Michigan in 1876. Two years later he went to the lead mine at Mine LaMotte Mo., which was owned by Rowland Hazard and managed by W. B. Cogswell. After a few years Mr. Cogswell gave up the active management of the mine to study the question of soda ash manufacture in the United States, as a result of which, The Solvay Process Co. was organized at Syracuse, N.Y.

Mr. Sanders took over the active management of the Missouri mine when Mr. Cogswell left, and continued as Mr. Hazard's representative until the mine was sold. Meanwhile the Solvay Co. had built the nucleus of its great works in Detroit under the direction of its present manager, A. H. Green, Jr. This plant grew rapidly and the business expanded so that Mr. Sanders was appointed assistant manager in 1897, and remained active in the management of the Detroit works until his death, on Mar. 29.

#### ARTHUR H. STORRS

After the sudden death of Arthur H. Storrs, of Scranton, on Sept. 22, the Board of Directors of the Engineers Society of Northeastern Pennsylvania passed the following memorial minute:

"No man served the Society in more important and diversified capacities than Arthur H. Storrs. He was constantly active upon various committees; he was Treasurer during the years 1894-95-96 and 1897;

second vice-president in 1915, elevated to the presidency in 1916, and a member of the Board of Directors and of the library committee at the time of his regrettable demise; so it can be truthfully said that his genius was the Society's guiding spirit for many years.

"Such was his character that his nearest social and business associates loved him the most, since they knew him the best; and he naturally brought to the Society a prime asset in the shape of much needed virtues; brotherly love and fraternal fellowship.

"So valuable was his professional work as civil, mining and consulting engineer that the Government early sought his services in the Great War, and so thoroughly did his disinterested patriotism possess him that he virtually became a sacrifice upon the altar of his beloved country. Surely no greater tribute can come to any man!

"In bidding farewell to him who but yesterday was one of us, we may well thank providence for his fine example to us of a worthy, noble and unselfish life."

#### RICHARD MEAD

Richard Mead was born in 1893, at Weston, Mass., and received his degree from Harvard University in 1915. In 1918, he entered the service of the United States and was sent to France with Battery C of the 101st Field Artillery. He saw active service at the front; for a short time, as Corporal, he was instructor at an A.E.F. artillery school, and was studying for a commission at the Saumur Artillery School at the time the armistice was signed. On Aug. 28, 1919, just one week after he was discharged from military service, he was killed while working around some electric wires. He became a Junior Associate of the Institute of Mining and Metallurgical Engineers in 1917.

#### FORTHCOMING MEETINGS OF SOCIETIES

| Organisation   | Place             | Date       |
|--|-------------------|------------|
|  |                   | 1919       |
| American Society of Mechanical Engineers...                | New York, N. Y.   | Dec. 2-5   |
| American Institute of Chemical Engineers....               | Savannah, Ga.     | Dec. 3-6   |
| Geological Society of America.....                         | Boston, Mass.     | Dec. 29-31 |
|  |                   | 1920       |
| American Society of Heating and Ventilating Engineers..... | New York, N. Y.   | Jan.       |
| Mining and Metallurgical Society of America..              | New York, N. Y.   | Jan. 13    |
| American Institute of Min. and Met. Engineers              | New York, N. Y.   | Feb. 16-19 |
| American Ceramic Society.....                              | Philadelphia, Pa. | Feb. 23-26 |
| American Electrochemical Society.....                      | Boston, Mass.     | Apr. 8-10* |

\* On Apr. 9, a joint meeting will be held with the A. I. E. E.

#### VOLUME 27 OF THE MINERAL INDUSTRY

The annual volume called *Mineral Industry*, founded by Richard P. Rothwell and now edited by G. A. Roush and Allison Butts, of Lehigh University, is off the press for 1918. This well known publication, now in its twenty-seventh year, has become a standard reference book for statistical work. It is published by the McGraw Hill Book Co., New York City.

## ENGINEERS AVAILABLE

(Under this heading will be published notes sent to the Secretary of the Institute by members or other persons introduced by members.)

**Mining Geologist.** Age, 34; wide experience in all Lake Superior iron-ore districts and Arkansas bauxite district. Examinations, tonnage estimates, reports, direction of prospecting, geologic mapping, churn and diamond drilling. Excellent references. A-2681.

**Mine Superintendent or Manager.** Graduate mining engineer, age 31, married, 10 years' experience, now in government employ as metallurgist, desires employment with reputable mining company. New York interview if desired. A-4219.

**Research Engineer,** now in Chile on erection of 50-ton mill with modern machinery for treatment of Chilean nitrate, desires connection, from the first of next year, with firm operating in South or Central America. A-4915.

**Mining Engineer.** Young graduate of Michigan College of Mines; capable of handling men, conscientious worker; desires a position that will lead to assistant superintendency. Any place in the United States. Initial salary relatively unimportant. A-5195.

**Metallurgist,** married, age 25; technical graduate; 3 years' experience in blast and open-hearth furnaces, blooming mills, metallographic, and heat treatment work; desires position as sales engineer in the Pittsburgh district. A-5196.

**Assistant Engineer.** 10 years' active experience in Canada and United States, 8 years of which has been in charge of large and small operations, desires to become assistant to consulting engineer active in mine operation. A-5197.

**Concentrator Superintendent.** Age 37; 16 years' milling experience in Western States and South America in crushing, grinding, concentration, and flotation. Past 12 years with two of the most prominent copper producers. Change desired. References furnished. A-5198.

**Mining Engineer.** Ex-captain engineers, 12 years' experience gold, silver, copper, lead; experience in examination, development, and operation; accurate, efficient, and excellent executive; 10 months on General Staff; organized and had charge two new corps in army. Available immediately. A-5199.

**Mine Superintendent.** First-class millman and miner. Can test ores for proper process and design and erect mill. Understands executive duties of the position, having superintended metalliferous mines in United States and Canada. A-4195.

**Manager or Superintendent.** Graduate Michigan College of Mines, 25 years' experience, lead, silver, zinc, copper and gold, in positions of responsibility as superintendent or manager of mining and milling operation, development and construction. Highest recommendation. A-4177.

**Engineer Executive.** Mining engineer; age 35; married. Practical experience mucking, mining, sampling, surveying, assaying, and accounting; last 8 years, executive in charge mine examinations, development and operation of metal mines, milling and general construction. Salary, \$4500. Available in March. A-5222.

**Manager-engineer.** Qualified in administrative and technical problems in mining, distillation, briquetting, and combustion of coal. Minimum salary, \$5000. A-5223.

**Mining Engineer.** Age 48, graduate; 7 years, engineering experience at mines; mine examinations; 4 years' editorial work; 8 years, statistics and research in connection with mine accidents, mine safety, and preparation of reports and papers on various mining subjects. Qualified for safety engineer, editor, professor in mining school, or mining engineer at mine in charge of operations. A-5224.

**Gold Mining, General Superintendent.** Technical graduate; age 34; 11 years' wide experience in mine, mill, and cyanide work. Has been in charge of prospecting, and several small mines and metallurgical plants. Desires connection that offers good future. Available January, 1920. A-5246.

**Consulting Engineer.** Has had over 20 years' experience in the examination and operation of mines. Especially familiar with the copper deposits and mines of Arizona. Specialist in economic geology. A-5247.

**Assistant Superintendent or Salesman.** Technical graduate; age 23. Experience in coal mining, desires position either in the Pittsburgh vein or with large eastern coal dealer. A-5248.

**Metallurgical Engineer.** 26 years old, Lehigh University graduate; 1 year's electric furnace experience; 2 years' with International Nickel Co., in cupola and converter department; desires position with some active smelting and refining company in the United States. A-5232.

**Lead and Copper Metallurgist.** Technical graduate; released from army; experience as manager in the design, construction and operation of large lead smelter and refining in Asia; familiar with latest practice in all operations involved in lead and copper smelting, lead refining, treatment of associated metals and by-products and in the design of furnaces and auxiliary equipment, successfully handled labor problems here and abroad. Available at once. A-4593.

**Graduate E. M.** Married, 18 years' experience with gold, silver, copper, and manganese in both mining and metallurgical fields on operating, research, examination and consulting work. Interested in temporary engagement, but desires connection leading to permanent position of responsibility; speaks Spanish fluently. A-5059.

**Geologist.** Graduate Columbia School of Mines, 1909, experienced in metal and oil geology, will be available Jan. 1. A-5263.

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## POSITIONS VACANT

**Correspondent.** Must be able, by virtue of connection, to forward daily and weekly reports, outlining conditions affecting economics of industries, particularly the metallurgical and chemical industries. New York City. R-1982.

**Sales Lubrication Engineer.** Preferably with experience as chief marine engineer familiar with internal-combustion engines and with automobile trade. Must be good salesman, of good appearance and be able to meet people. Middle West. Salary \$2700 to start. R-1984.

**Research Metallurgist.** Metallurgical engineering graduate with several years' experience in steel alloys. Detroit, Mich. R-2010 A.

**Commercial Metallurgist.** Extensive commercial experience in steel alloys; willing to travel; and capable of meeting customers; man between 30 and 40, with technical education, desired. Detroit, Mich. R-2010 B.

**Mechanical Engineer.** Especially fitted to make studies and drawings of equipment layouts and shops for manufacture of forgings, brass and steel drawing, machining of small brass parts, etc. Drawings will be made of the foundations, location of machines, counter-shafting, line shafting, etc. Philadelphia, R-2018.

**General Engineering Draftsman.** Familiarity with general plant layout work, piping, industrial equipment, etc. Vicinity of New York City. Salary depends on man. R-2021.

**Furnace Designer.** High-grade man who has had experience on industrial gas and oil-burning furnaces, also on fuel-oil systems for power plants. Massachusetts. R-2023.

**Superintendent of Hardening and Heating Room.** Experienced and capable of taking charge of department and cooperating with manufacturing departments in every way. Work is chiefly on production of small parts with some special toolroom work. Department consists of six furnaces. New York State. R-2029.

**Manager for District Office.** Thoroughly familiar with building trades and especially with reinforced-concrete industry; competent to oversee all details connected with operation district office. Salary \$3000 to \$5000 per year. R-2036.

**Mechanical Draftsman.** Should have served apprenticeship in blueprinting and tracing and have had from 2 to 6 years' experience in actual detail and layout work; also have working knowledge of machine designs and design of small parts. Age 26 to 40 years; married men preferred. Duties consist of general detail design and layout work in the drafting room on machines used in and articles produced in manufacture of kodaks and films. Rochester, N. Y. R-2041.

**Mining Engineer.** Young unmarried man, preferably an ex-service man. About 2 years' experience in mining work, though not necessarily in mining iron. Pennsylvania. Salary \$175-250, depending on man. R-2044.

**Electrochemical Engineer.** Experience in electrochemical refining of copper, and ability to design, construct, and operate plant for such purpose. England. R-2050.

**Research Metallurgist.** Good technical training and practical experience in manufacture of steel and its physical testing. Problem to be investigated is production of molybdenum steels with study of their properties. Work to be carried on by a Government Bureau in coöperation with an educational institution and a producing company. Salary \$2000-2500 per year. Colorado. R-2066.

**Instructors.** Engineers willing to teach should register with the Engineering Societies Employment Bureau. The Bureau has been called upon to fill more positions, varying in grade from laboratory assistant to head of department in the various engineering and technical schools of this country, than it has men registered. Registration blanks and other information may be had by addressing W. V. Brown, Manager, 29 West 39th Street, New York, N. Y.

**Topographical Draftsman.** Experience in topographic drawing for work in the Mexican Oil fields. Salary \$150 per month and all expenses. R-2067.

**Assistants in Metal-testing Laboratory.** A college graduate desired. Illinois. R-2069.

**Instructor in Physics.** Engineering graduate capable of teaching physics. Position offers the advantage of a thorough grounding in science and an excellent opportunity for advancement to a satisfactory commercial position. Vicinity of New York City. R-2075.

**Assistant Professor of Mathematics.** Qualified to assist temporarily in physics. Duties will consist of teaching 20 hours per week. Salary \$200 per month. Florida. R-2076.

**Foundry Superintendent.** Must be competent to take charge of a foundry employing about 80 men. New York State. R-2077.

**Draftsman.** First-class mechanical draftsman who has had experience in industrial smelter and refinery plants. Applicant should also have had experience in structural design, and be thoroughly competent to lay out both buildings and machinery. Application by letter. Salary, about \$45 per week. New Jersey. R-2084.

**Junior Mining Engineer.** Must have had about 2 years' experience. Duties will consist of examination and development work. 3 years contract. Salary \$275 and traveling expenses. Bolivia, S. A. R-2087.

**Mining or Civil Engineer.** Must have had experience in triangulation work. Knowledge of Spanish desirable, but not necessary. 3 year contract. Salary \$275 and traveling expenses. Bolivia, S. A. R-2088.

**Expert on Vanadium.** Must be A-1 man capable of handling a large vanadium proposition, which would entail recommendations for equipment, and complete supervision of construction and all details. Peru, S. A. R-2092.

**Electrolytic Refining.** Competent man with experience covering the principal departments of electrolytic copper refining. Must be prepared to go to Europe if necessary. State terms in application, also experience in design construction and operation, giving references. R-2050.

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## ENGINEERING COUNCIL JOINS NATIONAL CHAMBER OF COMMERCE

Engineering Council has been elected to membership in the Chamber of Commerce of the United States. Its representative will be Mr. Harold W. Buck, of Viele, Blackwell & Buck, Consulting Engineers, New York City, Past-president of the American Institute of Electrical Engineers, his alternate being Mr. Irving E. Moulthrop, of the Edison Electric Illuminating Co., Boston, member of American Society of Mechanical Engineers and American Institute of Electrical Engineers. The Chamber of Commerce of the United States was formed in 1912 and now consists of more than 1100 organizations in every state of the union, in the outlying possessions, and of all the principal American chambers of commerce abroad. One of the chief aims is to obtain the best business thought on national questions that concern business. Members of the National Chamber have the privilege of using all the facilities of the Chamber's offices in Washington when information is desired.

## PERSONAL

The following is an incomplete list of members and guests who called at Institute headquarters during the period Oct. 10, 1919, to Nov. 10, 1919.

|  |  |
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| Carl A. Allen, Salt Lake City, Utah.                             | W. G. Mitchell, Montreal, Canada.                  |
| M. M. Altmayer, Paris.   | Henry S. Munroe, Litchfield, Conn.                 |
| A. E. Bellis, Major Ord., Springfield Armory, Springfield, Mass. | J. S. Negru, New York, N. Y.                       |
| R. S. Botsford, New York, N. Y.                                  | Edmund Newton, New York, N. Y.                     |
| Henry S. Burnholz, Monterrey, Mexico.                            | A. W. Newberry, Cleveland, Ohio.                   |
| D. E. A. Charlton, New York, N. Y.                               | C. C. O'Harra, Rapid City, S. D.                   |
| C. C. Colburn, Denver, Colo.                                     | Fred S. Porter, Philadelphia, Pa.                  |
| C. V. Corless, Coniston, Ontario.                                | Donald A. Powell, Columbus, Ohio.                  |
| I. N. Dally, Seattle, Wash.                                      | Thomas T. Read, Washington, D. C.                  |
| E. V. Daveler, Butte, Mont.                                      | W. L. Remick, Chrome, N. J.                        |
| John Davis, Fairbanks, Alaska.                                   | Hallet R. Robbins, San Francisco, Calif.           |
| E. W. Engelmann, Salt Lake City, Utah.                           | Milnor Roberts, University Station, Seattle, Wash. |
| M. E. Erdofy, New York, N. Y.                                    | Thos. S. Roberts, Lakehurst Proving Grounds, N. J. |
| W. F. Ferrier, Toronto, Canada.                                  | George B. Rodgers, Dobbs Ferry, N. Y.              |
| H. A. Fisher, Pittsburgh, Pa.                                    | John C. Rogers, Copper Cliff, Ontario.             |
| Walter Fitch, Sr., Eureka, Utah.                                 | Joseph L. Rosenmiller, Bethlehem, Pa.              |
| C. D. Grier, New York, N. Y.                                     | C. J. Saville, Portland, New South Wales.          |
| A. Hibbert, London.  | W. A. Scheuch, New Jersey.                         |
| John E. Hodge, Minneapolis, Minn.                                | S. B. Shutts, Lynchburg, Va.                       |
| W. E. Hopper, Newark, N. J.                                      | E. W. Smith, U. S. Army.                           |
| M. R. Hull, McGill, Nev.   | S. J. Speak, London.                               |
| A. W. Ibbett, Trinidad, B. W. I.                                 | John B. Stewart, Santiago de Cuba, Cuba.           |
| A. O. Ihlseng, Joplin, Mo.                                       | S. A. Taylor, Pittsburgh, Pa.                      |
| Sherwin F. Kelly, Lawrence, Kans.                                | Karl Thomas, New York, N. Y.                       |
| R. G. Knickerbocker, Logansport, Ind.                            | F. L. Torres, Eureka, Nev.                         |
| M. H. Kuryla, Eureka, Colo.                                      | Henry Traphagen, Toledo, Ohio.                     |
| F. G. Lasier, Detroit, Mich.                                     | W. D. Van Doren, Ottawa, Canada.                   |
| David Lasuer, Elizabeth, N. J.                                   | J. A. Vernon, Newport, R. I.                       |
| H. H. Lauer, Allentown, Pa.                                      | James Wilding, San Francisco, Calif.               |
| J. Whitney Lewis, Care First Nat'l Bank, Tulsa, Okla.            | D. J. Williams, Butte, Mont.                       |
| James W. Love, Knoxville, Tenn.                                  | Harry J. Wolf, New York, N. Y.                     |
| Dorsey A. Lyon, Washington, D. C.                                | Dwight E. Woodbridge, Duluth, Minn.                |
| M. E. Martiner, Boston, Mass.                                    | Percy E. Wrighn, Seattle, Wash.                    |
| Benj. L. Miller, Bethlehem, Pa.                                  | F. Yamada, Tokyo, Japan.                           |
| W. G. Miller, Toronto, Canada.                                   |  |

Edward W. Berry and Joseph T. Singewald, Jr., of the Department of Geology, Johns Hopkins University, have returned from their geologic investigations in South America. Six months were spent studying the geology and mineral deposits of a number of districts in Peru, Bolivia and Chile. The trip was made through the George Huntington Williams Memorial Fund.

C. E. Carstens, of Anaconda, Mont., has accepted a position with the Andes Copper Mining Co. at Potrerillos, Chile.

L. K. Davis, a major of the tank corps, has been ordered from France to Armenia, where he will be Military Governor. Mrs. Davis sailed from New York the middle of October to join him.

Robert S. Davis has taken a position with Walker Bros. Consolidated Copper Co., at Portola, Calif.

Walter Dobbins, formerly with the Chino Copper Co. at Hurley, N. Mex., has gone to Chuquicamata, Chile, in the employ of the Chile Exploration Co.

**A. C. V. Drozdowski** since last May has been employed by the Spassky Copper Mine, Ltd. During a period of 2 months when the mill was nationalized by Bolsheviks, he was in charge of the mill, and was made assistant superintendent when the English Company took back the works.

**S. Ford Eaton**, who was for some time with the Olimpo de Valle, at Magangue, Columbia, is now located at Chloride, Ariz., where he is connected with the Dardanelles Mining Co.

**Walter I. Garms**, who served with the 23d Engineers, is now with the Ray Consolidated Copper Co. at Ray, Ariz.

**Louis J. Gurevich** has resigned his position of assistant physicist in metallurgy with the Bureau of Standards and has accepted the position of metallurgist in the research department of the Hydraulic Pressed Steel Co. at Cleveland, Ohio.

**James H. Hance** has resigned his position of valuation engineer of the Income Tax Unit at Washington, and has accepted the position of acting professor in charge of the Geology Department, at Denison University, Granville, Ohio.

**Joseph H. Hill** is now located at Tshikapa, Kasai Diamond Fields, Congo Belge, West Africa.

**K. L. Hussissian**, having recently been discharged from the army, has returned to his former position with the Inter-State Iron Co. at Virginia, Minn.

**Olaf P. Jenkins**, formerly of Tucson, Ariz., has accepted a position as geologist with A. C. Veatch, of the Sinclair Consolidated Oil Corp., 120 Broadway.

**J. D. Jones**, recently with the Illinois Steel Co., is now general superintendent of the Algoma Steel Corp. at Sault Ste. Marie, Canada.

**Takeshi Kawamura** has accepted a position with the Mitsubishi Iron and Steel Co., Marunouchi, Tokyo, Japan; he was formerly with the Kenjiho Iron and Steel Works at Koshugun, Kokaido, Korea.

**William H. Kobbé**, major Engineers U. S., has returned from military service in France and is now located with the Natural Resources Subdivision of the Income Tax Unit, Internal Revenue Bureau, Washington. Major Kobbé had his right hand blown off by a hand grenade in April, 1918.

**F. O. Martin** has resigned as mineral inspector of the U. S. Department of the Interior and is now geologist for the Union Oil Co., of California.

**E. P. Mathewson** has resigned as Director of the American Smelting and Refining Co., and the American Smelters Securities Co., and on November 1st opened an office as consulting engineer at 42 Broadway, New York.

**Gilbert F. Metz**, formerly of Hannibal, Mo., has accepted a position as designing engineer at the Atlas Portland Cement Co., at Northampton, Pa.

**W. H. Reber**, who has just been released from active duty as Engineer Ensign in the Navy, is with the Chile Exploration Co., at Chuquicamata, Chile.

**Frank M. Smith**, until recently general manager of the East Helena plant of the American Smelting & Refining Co., and associated with that

company since its organization, has accepted the position of assistant of the Bunker Hill & Sullivan Mining and Concentrating Co., at Kellogg, Ida., and will assume his new work Nov. 1, with headquarters in Spokane. When Mr. Smith was tendered a promotion with the American Smelting & Refining Co., which would have taken him to New York City, he hesitated to leave the western mountains for other fields and later accepted the position with the Bunker Hill Co.

Charles W. Tubby has been transferred by the Worthington Pump Machinery Corp. from its St. Paul office to the management of its Seattle office; his address is 203 Maynard Building, Seattle, Washington.

Carlos W. Van Law, formerly of Boston, Mass., is now with the Sinclair Consolidated Oil Corp., at 120 Broadway, New York.

R. T. Walker has resigned the superintendency of the Virginia Louise Mining Co. at Pioche, Nev., to become manager of the Ore Purchasing Department, United States Smelting, Refining, and Mining Company, at Salt Lake City, Utah.

L. G. Weeks, formerly at Cananea, Mexico, has been appointed instructor at Cornell University.

W. H. Wellman, of Montgomery, Ala., has accepted a position with the Tecopa Consolidated Mining Co., at Tecopa, Calif.

E. H. Wisser, of Berkeley, Calif., has accepted a position with the Ray Cons. Copper Co., at Ray, Ariz.

Louis A. Wright sailed for Italy with his family in October, to engage in professional work. His address is Via Parlamento 22, Rome, Italy.

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## PATENT OFFICE BILLS HANGING FIRE

The testimony given before the Patent Committee of the House of Representatives in connection with the bills to establish the Patent Office as an independent bureau, to establish a United States Court of Patent Appeals, and to increase the force and salaries in the Patent Office, has been completed. These bills were originated by the Patent Committee of the National Research Council and have received almost universal approval. The Committee of the House of Representatives is favorable to what this Committee of the Research Council is trying to accomplish but the proverbial inertia of Congress toward the Patent system needs outside stimulus.

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## A BOUQUET FOR THE ENGINEERING SOCIETIES EMPLOYMENT BUREAU

The following paragraph of appreciation of the Engineering Societies Employment Bureau is from the letter of a young engineer who found the Bureau of service.

"I wish to sincerely thank you for the services rendered. They are of immense value to anyone located as I am, in a small town without the opportunities for keeping in touch with openings in manufacturing lines."

## MEMBERSHIP

## NEW MEMBERS

The following list comprises the names of those persons who became members during the period Oct. 10, 1919, to Nov. 10, 1919.

- ABELL, O. J., Pres. & Treas., Abell-Howe Co., 332 South Michigan Ave., Chicago, Ill.  
 ADAMI, ARTHUR E., Asst. Prof. of Min. Engrg., Montana State School of Mines,  
 Butte, Mont.  
 BASSETT, R. H., Chief Engr., Hanna Ore Min. Co., Hibbing, Minn.  
 BOZA, HECTOR J., Cons. Engr., Boza Aizcorbe Hermanos, Box 106, Lima, Peru.  
 BROWN, HAROLD P., Cons. Concrete Engr., 120 Liberty St., New York, N. Y.  
 BUCHANAN, W. A., Mgr., Meteor Mine, Slocan City, B. C., Canada.  
 CAMERON, JAMES A., Supt., Ellsworth Collieries Co., Ellsworth, Pa.  
 CARPENTER, CRANSTON HOWE, Electro-Met. Engr., General Engrg. Division,  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.  
 CASTLETON, GEORGE T., Assayer, Custom Office, Box 122, Eureka, Utah.  
 CHAFFIN, C. E., Eastern Mgr., General Engineering Co.,  
 120 Broadway, New York, N. Y.  
 CLARK, WALTER R., Wks. Mgr., Bridgeport Brass Co.,  
 1875 Park Ave., Bridgeport, Conn.  
 CLARKE, ERNEST E., Min. Engr., Vinegar Hill Zinc Co.,  
 419 S. Court St., Platteville, Wis.  
 COOLIDGE, E. B., Mgr., Spotted Horse Mine, St. Paul Montana Min. Co.,  
 Maiden, Mont.  
 CORTELYOU, ARTHUR P., Resident Mgr., Potrero Min. Co., Mocorito, Sinaloa, Mexico.  
 COTTINGHAM, KENNETH, Pet. Engr., Hager & Robitaille, Delmonico Bldg.,  
 Fifth Ave. & 44th St., New York, N. Y.  
 CREW, J. A., Mgr., Research Dept., Pittsburgh Steel Co., Monessen, Pa.  
 CUMMINGS, LISTER M., Efficiency Engr., Copper Queen Branch,  
 Phelps-Dodge Corp., Box 1539, Bisbee, Ariz.  
 DANFORTH, GEORGE L., JR., Asst. Gen'l Supt., Illinois Steel Co.,  
 South Works, South Chicago, Ill.  
 DAWSON, EUGENE H., Cons. Engr., 42 Broadway, New York, N. Y.  
 DOBBINS, WILLIAM J., Supt., American Agricultural Chem. Co., Dumfries, Va.  
 FABER, HENRY B., Cons. Chem., Industrial Filtration Corp.,  
 115 Broadway, New York, N. Y.  
 FLEMING, JOSEPH P., Chem. Engr., 50 Broad St., New York, N. Y.  
 GALVIN, JOHN E., Pres., The Ohio Steel Foundry Co., Lima, Ohio.  
 GOODWIN, JAMES A., American Trading Co., 25 Broad St., New York, N. Y.  
 GROSSMANN, MARCUS A., Met., Vanadium Corp. of America, Bridgeville, Pa.  
 HARNSEBERGER, T. K., Geol., Roxana Petroleum Corp., Box 930, Cheyenne, Wyo.  
 HATCH, ROY, Supt. of Mills, Alaska-Gastineau Min. Co., Thane, Alaska.  
 HAYES, D. I., Gen'l Supt., Wisconsin Zinc Co., Benton, Wis.  
 HODSON, FRANK, Met. Engr., Pres., Electric Furnace Construction Co.,  
 402 Finance Bldg., Philadelphia, Pa.  
 HOME, WILLIAM LATSHAW, Min. Engr., Salt Lake City Engrg. Dept.,  
 Salt Lake City, Utah  
 HOPKINS, ROBERT H., Asst. Supt. of Leasing, Arizona Copper Co., Ltd.,  
 Box 684, Morenci Ariz.  
 JEWELL, WILLIAM E., Supt., Continuous Mill, Inland Steel Co., Indiana Harbor, Ind.  
 KATSEY, EDWIN, Min. Engr., The Annapolis Lead Co.,  
 Suite 1002, Times Bldg., St. Louis, Mo.  
 KENT, WILLIAM, Smelter Supt., International Nickel Co.,  
 Copper Cliff, Ont., Canada.  
 KILDAL, HERMANN, Min. Engr., Bibilonia Mine, La Libertad, Nicaragua, C. A.  
 KOWALKE, OTTO L., Prof. of Chem. Engrg., Univ. of Wisconsin, Madison, Wis.  
 KRUGER, H. A., Cons. Engr., 711 Clark Ave., St. Louis, Mo.  
 LOEFFLER, GEORGE O., Met., Gen'l Supt., Carbon Steel Co.,  
 Foot of 32d St., Pittsburgh, Pa.

- McCAULEY, W. J., Min. Engr., Head Transitman, Ray Cons. Copper Co.,  
Box 695, Ray, Ariz.
- McFARLAND, W. H. S., Min. Engr., Supt. of Dredges & Thawing,  
Yukon Gold Co., Dawson, Y. T., Canada.
- McNULTY, HUGH W., Stope Engr., Ray Cons. Copper Co., Box 195, Ray, Ariz.
- MAY, JOHN G., Min. & Cons. Engr., Brown Palace Hotel, Denver, Colo.
- MITCHELL, SAMUEL STANTON, Supt. of Mines, Embree Iron Co., Embreeville, Tenn.
- MORGAN, THOMAS F., Chief Min. Engr., Madeira Hill Coal Min. Co., Philipsburg, Pa.
- MYERS, C. A., Mgr., Mesabi Range Properties, Coates & Tweed, Nashwauk, Minn.
- NEAD, JOHN H., Research Met., The American Rolling Mill Co., Middletown, Ohio.
- NELSON, NED E., Min. Engr., Granby Cons. Min., Smelt. & Power Co., Ltd.,  
Phoenix, B. C., Canada.
- NYBERG, H. E., Asst. Gen'l Mgr., Cia. Minera Las Dos Estrellas, S. A.,  
El Oro, Mexico.
- OHASHI, TETSUO, Min. Engr., Kuhara Min. Co., Hidachi Mine, Ibarakiken, Japan.
- PACKARD, IVAN R., Cons. & Min. Engr., 210-13 A. O. U. W. Bldg., Little Rock, Ark.
- PEGG, FRED EARL, Chem., C. M. Fassett Co., Spokane, Wash.
- PENNY, FREDERICK WILLOUGHBY, Economic Geol., Trinidad Leaseholds, Ltd.,  
Point-a-Pierre, Trinidad, B. W. I.
- PINSON, CLAUDE J., Supt. of Mines, Compania de Minerales y Metales, S. A.,  
Higuera, Coah., Mexico.
- PLUMMER, HOWARD CLARK, Supt. & part owner, Niles Sand, Gravel & Rock Co.,  
Niles, Cal.
- PROUT, F. S., Geol., Pomeroy & Hamilton, 729 Kennedy Bldg., Tulsa, Okla.
- QUIGLEY, JOHN VIR, Met. Engr., Minerals Separation, North American Corp.,  
220 Battery St., San Francisco, Cal.
- RAIFFEISEN, OTTO J., Chief Draftsman, Arizona Copper Co., Box 1443, Clifton, Ariz.
- RAIGUEL, EDWARD B., Civil, Min. & Cons Engr., Chief Engr., W. H. Cunningham,  
802 First National Bank Bldg., Huntington, W. Va.
- RETTEW, E. W., Cons. Met., 420 Franklin St., Reading, Pa.
- ROLLASON, GEOFFREY M., Met., Lynite Laboratories, Aluminum Castings Co.,  
2800 Harvard Ave., Cleveland, Ohio.
- RUTLIDGE, CHARLES S., Britannia Min. Co., Inc., Cuba 71, Habana, Cuba.
- SAMPSON, JAMES MILES, Supt. Foundry, Watertown Arsenal, Watertown, Mass.
- SCHAD, LLOYD W., Met., Westinghouse Lamp Co., Bloomfield, N. J.
- SHAPLEY, EDWIN, 1404 Whitney-Central Bldg. New Orleans, La.
- SHAW, F. MASON, Office Engr., Chile Exploration Co., Chuquicamata, Chile.
- STUEBING, W. C., Gen'l Mgr., Helvetia Copper Co.,  
414 National Bank of Commerce Bldg., San Antonio, Texas.
- STRICKLAND, CHARLES W., Gen'l Mgr., Don Coal Co., Box 910, Huntington, W. Va.
- SUZUKI, TOMIJI, Min. Engr., Kuhara Min. Co., Hitachi Mine, Ibarakiken, Japan.
- TEDROW, H. L., Shiftboss, Burro Mountain Branch, Phelps-Dodge Co.,  
Box 122, Tyrone, New Mexico.
- THERIAULT, A., Major, Dept. of Militia & Defence, Ordnance College,  
Red Barracks, Woolwich, London, S. E., England.
- THOMAS, BRET HARTE, Mine Foreman, Arizona Hercules Copper Co.,  
Box 76, Ray, Ariz.
- THORNTON, EDMUND A., Asst. Supt. of Mines, Ray Cons. Co., Box 244, Ray, Ariz.
- THWING, CHARLES BURTON, Pres., Thwing Instrument Co.,  
3339 Lancaster Ave., Philadelphia, Pa.
- VALENTINE, I. R., Met., Chief of Test. Laboratory, General Electric Co.,  
Erie Works, Erie, Pa.
- VIRGIN, ROBERT ZERUBBABEL, Asst. Prof. of Coal Min., Carnegie Institute of Tech.,  
Schenley Park, Pittsburgh, Pa.
- WILDER, R. T., Supt., Compania Metalurgica Nacional, Matehuala, S. L. P., Mexico.
- WYMAN, THOMAS NOEL, Gen'l Supt., Embree Iron Co., Embreeville, Tenn.
- ZIMMERMAN, THOMAS M., Chief Engr., Washington Coal & Coke Co., Dawson, Pa.

### Associates

- BROWN, EDMUND G., Mill Met., Braden Copper Co.,  
Sewell via Rancagua, Chile, S. A.
- BURT, HARRY R., Geol., Texoleon Oil Co., Olean, N. Y.
- COX, DANIEL J., Chief Met., Remington Arms, U. M. C. Co.,  
Bridgeport Works, Bridgeport, Conn.

DALY, MARCUS.....Treas., Cinco Minas Co., 61 Broadway, New York, N. Y.  
 HENTON, HUGH M.....Met. Engr., Case School of Applied Science, Cleveland, Ohio.  
 LAWRENCE, HORACE MARSHALL, Met., Kennecott Copper Corp., Latouche, Alaska.  
 NORTON, JOHN EDWARD.....239 Colorado St., Butte, Mont.  
 QUINCY, CHARLES F.....Pres., Q. & C. Co., 90 West St., New York, N. Y.  
 ROBINSON, J. W.....Hotel Elliott, Sturgis, Mich.  
 SEYMS, ROBERT W., Western Sales Mgr., Taylor Wharton Iron & Steel Co.,  
 509 Insurance Exchange Bldg., San Francisco, Cal.  
 SOULE, THOMAS, Chief Sampler, Arizona Copper Co. Ltd., Box 434, Morenci, Ariz.  
 WHATLEY, WILLIAM JEWELL, Transimman, Wenonah Division, Tenn.,  
 Coal, Iron & R. R. Co., R. F. D. No. 2, Bessemer, Ala.

### *Junior Associates*

BILHARZ, O. W.....Student, Michigan College of Mines, Houghton, Mich.  
 CAIRNS, ARTHUR L.....Student, Missouri School of Mines, Rolla, Mo.  
 CHRISTIE, LAURENCE G.....Student, Univ. of California, Berkeley, Cal.  
 CROOK, THEO.....Student, Univ. of California, Berkeley, Cal.  
 HAINES, HAROLD FREDERICK.....Student, Colorado School of Mines, Golden, Colo.  
 MILKWICK, CLIFFORD F., Min. Engr., Asst. Testing Engr., Anaconda Copper Min. Co.  
 Anaconda, Mont.  
 OLSON, P. W.....Student, Univ. of California, Berkeley, Cal.  
 PETERSON, MARCUS C.....Student, Univ. of California, Berkeley, Cal.  
 SHANFELD, SAMUEL NORMAN.....Student, Missouri School of Mines, Rolla, Mo.  
 TUNG, TENG-SHAN.....Student, Univ. of California, Berkeley, Cal.  
 WYNNE, VICTOR AINSLIE, Student, Massachusetts Institute of Tech.,  
 Cambridge, Mass.

### *Change of Status, Junior Associate to Associate*

HORCASITAS, A. S., Min. Engr., South American Development Co.,  
 Apartado 655, Guayaquil, Ecuador, S. A.  
**Total Membership Nov. 10, 1919.....7835**

### *Members' Addresses Wanted*

| Name  | Last address of Record from which Mail has been returned.  |
|---|--|
| ANDERSON, L. W.....   | Boston Mine, Utah Copper Co., Bingham, Utah.               |
| ARMSTRONG, E. W.....  | Mina Bibilonia, La Libertad, Nicaragua, C. A.              |
| BIRD, FRANK H.....  | Butler Hotel, Seattle, Wash.                               |
| BREEDING, F. O.....   | Eden Min. Co., Bluefields, Nicaragua.                      |
| BROWN, W. SINCLAIR.....   | Air Board Offices, Swansea, England.                       |
| CALLEN, ARTHUR S.....   | 3510 N. 16th St., Philadelphia, Pa.                        |
| CAMPBELL, W. C.....   | Care Ivanpoh Min. Co., Cima, Cal.                          |
| CARPENTER, E. LEON.....   | Box 397, Salisbury, Md.                                    |
| CARROLL, GEORGE A.....  | Pacific Coast Borax Co., Ryan, Cal.                        |
| CRONIN, PAUL B.....   | 1453 Oak St., Glendale, Cal.                               |
| DETEBT, WILLIAM F.....  | Jackson, Amador Co., Cal.                                  |
| DONAHOE, JOHN E.....  | Connecticut Zinc Corp., Oronogo Circle Mines, Oronogo, Mo. |
| EISSLER, MANUEL.....  | Hong Kong Club, Hong Kong, China.                          |
| FLAHERTY, ROBERT H.....   | 74 King St., E., Toronto, Ont., Canada.                    |
| GLEASON, VILLEROY, JR., Machinery Dept., Mine & Smelter Supply Co.,<br>121-125 West 2d So. St., Salt Lake City, Utah. |  |
| HERR, J. CAMPBELL.....  | Box 556, State College, Pa.                                |
| KAMMERER, CHARLES.....  | Box 412, San Francisco, Cal.                               |
| KING, FRANK E.....  | Hotel Breslin, New York, N. Y.                             |
| KLINE, HARRY D.....   | Ray Cons. Copper Co., Ray, Ariz.                           |
| KLUGESCHIED, WALTER P.....  | 616 W. 13th St., New York, N. Y.                           |
| LEVAT, DAVID.....   | 174 Blvd. Malesherbes, Paris, France.                      |
| MCCRAY, H. E.....   | Humboldt, Ariz.  |
| MCINTYRE, JOHN E.....   | Ocean Park, Cal.   |
| MCINTOCK, A.....  | Hermon, St. Lawrence Co., N. Y.                            |
| MATTHIAS, MAXIMILIAN PAUL, Lieut., Ordnance Dept., U. S. A.,<br>194 Nesmith St., Lowell, Mass.                        |  |

|                             |   |
|-----------------------------|---|
| MINISTER, H. L.....         | The Empire Zinc Co., Kelly, N. Mex.                 |
| NAHL, A. C.....             | 1079 Monadnock Bldg., San Francisco, Cal.           |
| PORTER, JAMES CLARKE, Mgr., | Coal Exploration Dept., E. J. Longyear Co.,         |
|                             | 413 National Bank of Commerce Bldg., St. Louis, Mo. |
| ROWE, FREMONT S.....        | Supt., Hecla Mine, Burke, Idaho.                    |
| SCHNEPP, C. F.....          | 307 S. Club Walk, Penns Grove, N. J.                |
| STICKNEY, WILLIAM H.....    | 708 N. Center St., Reno, Nev.                       |
| TINGLEY, T. W.....          | Beutree, W. Va.                                     |
| WOO, W. K.....              | M 70 Sing Kong Li, Minghong Road, Shanghai, China.  |
| WRIGHT, FREDERICK S.....    | Supt., Butte & Great Falls Min. Co., Neihart, Mont. |

## NECROLOGY

The deaths of the following members were reported to the Secretary's office during the month Oct. 10, 1919, to Nov. 10, 1919.

| Date of Election. | Name.                 | Date of Death.  |
|-------------------|-----------------------|-----------------|
| 1917              | Mead, Richard.....    | Aug. 28, 1919.  |
| 1916              | Miller, Cary R.....   | Nov. 9, 1919.   |
| 1903              | Oldfield, F. W.....   | Aug. 18, 1919.  |
| 1917              | Rogers, G. C.....     | 1918.           |
| 1911              | Storrs, Arthur H..... | Sept. 22, 1919. |

## CANDIDATES FOR MEMBERSHIP

**APPLICATION FOR MEMBERSHIP.**—The Institute desires to extend its privileges to every person to whom it can be of service. On the other hand, it is not desirable that persons should be admitted to membership in classes for which they are not qualified. Members of the Institute can be of great service if they will make a practice of glancing through the list of applicants and promptly notifying the Committee on Membership, or the Secretary of the Institute, of any persons whom they think should not be classified in accordance with the list given.

*Applications Lacking Endorsement*

Applications for membership have been received from Mr. Humenry and Mr. Sorenson, whose records are given below. These applications lack the necessary number of endorsers, but since these candidates live at some distance from the headquarters of the Institute, their records are published here in order that any members who are acquainted with them may be advised of the circumstances and may have an opportunity of writing to the Secretary endorsing these candidates.

*Member*

**Roger Deschamps, Brussels, Belgium.**

Present position: Cons. Engr. with Gustave Beschamps.

Proposed by Percy E. Barbour, E. Gybbon Spilsbury.

Born 1892, Dampremy, Belgium. Engr. course, Univ. Louvain. Automobile constr., office of Belgin Field Army. 1914-15, Belgian Army. 1915-18, Belgian Tech. Officer. 1908, Cons. engr. with father. 1919, Engr., Steel Plants, Société Athens., Liège.

**Joseph Humenry, Douai, France.**

Present position—1918 to date: Director of the service of grouping the colliery victims of the invasion.

Proposed by Arthur H. Wethey.

Born 1874, Aurillac, France. 1911-17, Engr. of Mines in Dasreville & Anrin. 1907-14, Principal Engr. of Mines of Liévin. 1914, Chief Engr. of Mines of Liévin.

**James Sorenson, Clintonville, Wis.**

Present position—1918 to date: Met. Engr., Four Wheel Drive Auto Co.

Proposed by

Born 1890, Racine, Wis. 1908-09, Racine College of Commerce. 1910-12, Chicago Technical College. 1915, Iron & Steel Analysis, Marquette Univ. 1914-17, Met., Gemco Mfg. Co., Milwaukee, Wis. 1917-18, Engr. of Tests, Cannon Forgings, U. S. Army.

### *Associate*

**Joseph Van Lierde, Sottegem, Belgium.**

Present position: Cons. Engr., associated with Gustave Deschamps.

Proposed by Percy E. Barbour, E. Gybbon Spilsbury.

Born 1883, Sottegem, Belgium. 1903-08, Univ. of Louvain, M. E. & E. E. 1908-09, Cornell Univ., New York, M. E. 1909-10, Asst. Supt. & Engr., Metz Factory, Motor Car Co., Waltham, Mass. 1910, Took over father's position as cons. engr. 1913, Prof., State Sch. of Horticulture in Ghent.

The following persons have been proposed during the period Oct. 10, 1919, to Nov. 10, 1919, for election as members of the Institute. Their names are published for the information of Members and Associates, from whom the Committee on Membership earnestly invites confidential communications, favorable or unfavorable, concerning these candidates. A sufficient period (varying in the discretion of the Committee, according to the residence of the candidate) will be allowed for the reception of such communications, before any action upon these names by the Committee. After the lapse of this period, the Committee will recommend action by the Board of Directors, which has the power of final election.

### *Members*

**Robert M. Adams, Duluth, Minn.**

Present position—1916 to date: Mgr., North Range Iron Co. and 1918 to date, Pres. Adbar Dev. Co.

Proposed by W. G. Pearsall, H. L. Hollis, Francis G. Fabian.

Born 1890, Deerwood, Minn. 1908-12, Cornell Univ. 1913-18, Adbar Dev. Co.

**Howard Clinton Arnold, Washington, Pa.**

Present position: Cons. Chem. Glass Industry, Assoc. with A. L. Dewal.

Proposed by Ellis Lovejoy, H. H. Stoek, J. R. Fleming.

Born 1891, Chicago, Ill. 1910, Chicago Schools. 1910-14, Univ. of Illinois. 1915-16, Ohio State Univ. 1917, Univ. of Michigan, B. S., M. A. 1910-14, Univ. of Illinois. 1914-16, Secy. & Gen'l Mgr., Ceramic Supply & Const. Co., Columbus, O. 1915-16, Ohio State Univ. 1916-17, Instructor, Univ. of Illinois. 1917, Summer School, Univ. of Michigan, Ph. D. 1917-19, Research Division, Chem. Warfare Service.

**Francis Clarke Atwood, Boston, Mass.**

Present position—1917 to date: Research Engr., Kalmus Comstock & Westcott, Inc.

Proposed by Edward E. Bugbee, Chas. E. Locke, Henry M. Schleicher.

Born 1893, Salem, Mass. 1910-14, Mass. Inst. Tech., S. B. 1914-15, Staff, Dept. of Physics. 1915-16, Inst. Dept. Physical Chem., M. I. T. 1915, Cons. wk., dev. special arc light, Kalmus Comstock and Westcott, Inc. 1916-17, Research Engr. & Met., The Exolon Co.

**Massy Baker, Ottawa, Ont., Canada.**

Present position: Asst. Surveyor, Geol. Survey.

Proposed by Percy C. Dobson, Joseph Daniels, J. T. K. Crossfield.

Born 1888, London, England. 1897-04, Sch., Tipperary, Ireland. 1909-13, McGill Univ., Montreal, Canada. 1910-11, Asst., Surveyor, Motherlode mine, Greenwood, B. C., Canada. 1912, Asst. Geol., Geol. Survey, Ottawa, Canada. 1913, Asst. Surveyor, Long Lake mine, Naughton, Ont., Canada. 1913-14, Hydrographic Surveyor, Mond Nickel Co. 1914-19, Capt., Canadian Engrs. and Royal Engrs. 1919, Asst. Geol., Geol. Survey, Ottawa, Ont., Canada.

**Samuel Seymour Ball, Bethlehem, Pa.**

Present position—1917 to date: Supt., Open Hearth No. 1, Bethlehem Steel Co.

Proposed by Chesley C. Thornburg, H. Merryweather, M. L. Jacobs.

Born 1889, Elmira, N. Y. 1909–13, Lafayette College, E. M. 1912, summer, Carpenter Foreman, T. A. Gillespie & Co., Fulton, N. Y. 1913, Constr., Globe Theatre, J. G. Doak & Co., Philadelphia, Pa. 1914, Foreman, Consolidated Engrg. Co., Baltimore, Md. 1914–15, Helper, Open Hearth Furnace; 1915, Asst. Melter; 1915–17, Asst. Supt., Open Hearth No. 1, Bethlehem Steel Co.

**Vivian Charles Barnett, New York, N. Y.**

Present position: Unemployed.

Proposed by R. M. Raymond, F. H. Minard, J. H. Batcheller.

Born 1885, London, England. 1900–02, Radley College, England. 1902–03, London Univ. 1903–05, Royal Sch. Mines, England. 1907, Cyanide Chem. & Assayer. 1907–09, Mine Surveyor & Sampler, Mont. Inc. Co., Marysville, Mont. 1909–13, Mine Surveyor & Sampler, Tomboy G. M. Ltd., Telluride, Colo. 1913, Asst. on examination, Spitzbergen. 1914, Examination of min. property, So. Africa. 1914–17, Private practice, N. Y. 1917 to date. In charge of all map wk., Amer. Section, Supreme War Council, Versailles, France.

**Florence Bascom, Bryn Mawr, Pa.**

Present position: Prof. Geol., Bryn Mawr College.

Proposed by George Otis Smith, Arthur C. Spencer, C. K. Leith.

Born Williamstown, Mass. 1878–87, Univ. of Wis. 1891–93, Johns Hopkins Univ., A. B., B. L., B. S., M. A., Ph. D. 1893–95, Instructor in Geol. & Petrol., Ohio State Univ. 1895–05, Lecturer, Assoc. Prof., Bryn Mawr College. 1896–09, Geol. Asst., United States Geol. Survey. 1909 to date, Geol., United States Geol. Survey.

**Carl H. Beal, San Francisco, Calif.**

Present position: Cons. Geol. &amp; Engr.

Proposed by Chester W. Washburne, A. F. Lucas, Ralph Arnold.

Born 1889, Western Kans. 1912, Stanford Univ., A. B. 1913, Asst. Geol., Kern Trading & Oil Co. 1913–14, Geol., H. R. Johnson, Los Angeles, Calif. 1914–15, Instr. Geol. & Min., Stanford Univ. 1915–19, Pet. Geol., U. S. Bureau Mines. 1918–19, Special Agent, U. S. Bureau of Internal Revenue. 1919, In Mexico, on geol. exploration.

**Benjamin Harvey Bennetts, Tacoma, Wash.**

Present position: Operating Chem. &amp; Met. Lab.

Proposed by Karl Eilers, Judd Stewart, D. C. Bard.

Born 1876, Moonta Mines, Australia. Ballard Sch. of Mines, Australia. 1901–06, Charge of Tacoma smelter. 1906–08, Supt., Garfield smelter, Utah. 1 yr., in charge smelter at Hadley, Alaska. 3 yrs. in charge of mines & smelter, Humboldt, Ariz.

**Levi Avis Billips, Lynch, Ky.**

Present position—1917 to date: Div. Engr., U. S. Coal &amp; Coke Co., Lynch, Ky.

Proposed by Howard N. Eavenson, Edward O'Toole, Henry W. Saunders.

Born 1885, Tip Top, Va. Common Free School. 1902–05, Chairman on land outcrop & mine surveys. 1905–13, Transitman & Draftsman. 1913–17, Prospecting in W. Va., Va., Ky., Ohio, Tenn. & Ill. for U. S. Coal & Coke Co.

**Harold Otis Bosworth, Denver, Colo.**

Present position—1918 to date: Pres., The Denver Fireclay Co.

Proposed by R. W. Gordon, Stuart Croasdale, Frank E. Shepard.

Born 1880, Denver, Colo. 1898, Denver Public Sch. 1902, Mass. Inst. of Tech., B. S. 1902–09, Factory Supt., Denver Fireclay Co. 1910–12, Mgr., Assay Dept., Mine & Smelter Supply Co., Denver, Colo. 1912–13, Mgr., Allentown Brick Co., Allentown, Pa. 1914–15, Mgr., German-Amer. Stoneware Wks., New York, N. Y. 1916–18, Mgr., White Tar Co., of N. J., Jersey City, N. J.

**Leonidas James Boucher, Hannibal, Mo.**

Present position: Quarry Supt., Atlas Portland Cement Co.

Proposed by Ray E. Hoffman, Fred T. Agthe, A. L. McRae.

Born 1890, Marshalltown, Ia. 1904–08, Marshalltown High Sch. 1909–14, Mo. Sch. of Mines, B. S. 1908–09, Asst. to Supt., Fentress Coal & Coke, Co. Wilder, Tenn. 1911–12, Mine Surveyor & Engr., Utah Copper Co., Bingham, Utah. 1914–15, Mine Foreman, Arctic Coal Co., Island of Spitzbergen. 1915–16, Asst. to Plant Engr.; 1916–19, Asst. Quarry Supt.; 1919 to date, Quarry Supt., Atlas Portland Cement Co., Hannibal, Mo.

**Thomas Monteith Broderick**, Minneapolis, Minn.

Present position—1914 to date: Asst. Prof. in Geol. and Mineralogy, Univ. of Minnesota.

Proposed by A. N. Winchell, Frank F. Grout, W. H. Emmons.

Born 1889, Waukesha, Wis. 1909–13, Univ. of Minn. 1913–14, Univ. of Wis. 1919, Harvard & Mass. Inst. of Technology, Ph. D.

**Eugene Childs Brook**, Rochester, Vt.

Present position—1915 to date: Min. & Mech. Engr., Eastern Tale Co. of Boston, Mass.

Proposed by C. B. Hollis, James E. Dick, R. M. McHugh.

Born 1887, Cambridge, Mass. 1899–1903, Rindge Tech. Sch. 1903–07, Dartmouth College. 1907–09, Colo. Sch. of Mines, B. S. & E. M. 1909–10, Miner, Highland Mary mine, Arpad mine, Silverton, San Juan Co., Colo. 1910–11, Leasing, Unexpected mine, La Plata Mts., Colo. 1911–13, Mgr., East Lode Devel. Co., Kinsley, Mariposa Co., Calif. 1913–14, Engr. & Supt., Imperial Water Co. No. 2, Holtville, Calif. 1914–15, Constr., Weyerhaeuser Lumber Co., Mill B., Everett, Wash.

**Robert Wesley Brown**, Pittsburgh, Pa.

Present position—1917 to date: Asst. Valuation Engr., Oil & Gas Section, Bureau of Internal Rev., Treasury Dept., U. S. A.

Proposed by Frank A. Herald, Charles R. Eckes, Ralph Arnold.

Born 1890, Conde, S. D. 1908–11, Northwestern Univ. 1912–14, Univ. of Ill. 1914–15, Univ. of Chicago, B. S., M. S. 1912–15, Working in mines of S. W. Wis. as Rodman, Drillers Asst., Laborer & Assayers Helper. 1913, Collecting well data, Ill. State Geol. Survey. 1915, Wis. Geol. Survey, exploration for iron ore. 1915–16, Taught Geol., Univ. of Okla. 1916–17, Head Geol., Lewcinda Oil Co., Bartlesville, Okla. 1915–19, Military Service, U. S. A.

**Charles L. Burdick**, New York, N. Y.

Present position: Met. Engr., Chile Exploration Co.

Proposed by Colin G. Fink, H. O. Hofman, C. S. Witherell.

Born 1892, Denver, Colo. 1911, Drake Univ., B. S. 1913–14, Mass. Inst. Tech., B. S. & M. S. 1914, Univ. of Basle, Ph. D. & Univ. of Berlin. 1916, Univ. of London. 1913–14, Asst. Theoretical Chem., Mass. Inst. Tech. 1914–15, Research Fellow, Kaiser Wilhelm Inst. fur Chemie und Elektrochemie, Berlin. 1915–16, Research wk., Univ. of Berlin. 1916, Research wk., Univ. of London. 1916–17, Research Instr., Mass. Inst. Tech. & Throop College of Tech. 1917–18, 1st Lieut., Ordn. Dept., U. S. A.

**Lancaster Demorest Burling**, Ottawa, Canada.

Present position—1913 to date: Invertebrate Paleontologist, Geol. Survey of Canada.

Proposed by A. N. Winchell, W. J. Mead, Stephen Royce.

Born 1882, Anita, Iowa. 1901–05, Univ. of Wisconsin, B. S. G. E. 1905–07, Asst. Geol., U. S. Geol. Survey. 1907–12, Asst. Curator, U. S. Nat. Museum.

**Gurdon Montague Butler**, Tucson, Ariz.

Present position—1915 to date: Dean, College of Mines & Engrg., Univ. of Ariz.

Proposed by Arthur J. Hoskin, Victor C. Alderson, Charles E. Van Barneveld.

Born 1881, Lake Geneva, Wis. 1898–02, Colo. Sch. of Mines, E. M. 1902–03, Engr., Big 40 Min. Co., Idaho Springs, Colo. 1903–12, Instr., Asst. Prof.; Assoc. Prof., Geol. & Miner, Colo. Sch. of Mines. 1913–15, Assoc. Prof. Min. & Prof. Geol., Sch. of Mines, Oregon Agricultural College. 1908–13, Geol., Colorado Geol. Survey. 1915, Geol., Oregon Bureau of Mines & Geol. 1917 to date, Pres., Southwestern Society of Engrs.

**Edward Winslow Campion**, Columbus, O.

Present position—1909 to date: Asst. Supt., Buckeye Steel Castings Co., Columbus, O.

Proposed by Lawford H. Fry, Orville Campbell Skinner, A. A. Stevenson.

Born 1883, Troy, N. Y. 1902–06, Cornell Univ., M. E., in Chg. of Chem. & Met. Lab., Buckeye Steel Castings Co.

**Douglas Calvert Corner, Joplin, Nev.**

Present position: Resident Mgr., Butte-Kansas Mines, Waco, Mo.

Proposed by W. N. Smith, Howard I. Young, M. H. Newman.

Born 1891, Baltimore, Md. 1905-09, Baltimore Polytechnic. 1910-13, Univ. Wis., B. S. 1913-14, Prospecting in Ga., Pfistu-Vogel Co. of Milwaukee & Supt. roaster, Cuba City, Wis., for Wis. Zinc Co. of Platteville, Wis. 1914-15, Instructor, State Min. School, Platteville, Wis. 1915-16, Supt., Champion mine, for Wis. Zinc Co.; Supt., Federal mine; Supt., Golden Rule mine, Wis. Zinc Co., at Granby, Wis. 1917-18, Supt., Davey mines, Amer. Zinc Co., Cartersville, Mo. 1918 to date, Mgr., Butte-Kansas mines, Waco, Mo., for Hallgarten Co., N. Y.

**John M. Davis, St. Clairsville, Ohio.**

Present position—1918 to date: Min. Engr., Oco Coal Co.

Proposed by Franklin K. Day, Homer C. Althar, E. B. Moore.

Born 1885, Bellaire, Ohio. 1905-08, Franklin College, W. Va. 1906-07, Wesleyan College. 1909-13, Transitman & Asst. Div. Engr., Cons. Coal Co., Fairmont, W. Va. 1913-16, Asst. Engr., Youghigheny & Ohio Coal Co., Barton, Ohio. 1916-17, Min. Engr., Provident Coal Co., St. Clairsville, Ohio. 1917-18, Mine Supt., Clarkson Coal Min. Co., St. Clairsville, Ohio.

**Jean Deschacht, Brussels, Belgium.**

Present position—1912 to date: Chief Engr., Union Minière du Haut Katanga.

Proposed by P. K. Horner, A. E. Wheeler, Jules Cousin.

Born 1877, Turnhout, Belgium. Till 1893, Commercial Coll., Ypres. 1893-95, Royal Atheneum, Louvain. 1895-1900, Military Hgh. Sch., Brussels. 1900-02, Officer in Belgian Military Engr. Corps. 1902-10, Engr. & Supt. Railways, 1910-12. Engr. & Asst. Mgr., Baume et Mercier.

**Felix Julius DeWilde, Galena, Ill.**

Present position—1915 to date: Min. Engr. & Gen'l Supt., Frontier Min. Co. & Burr Min. Co. 1917 to date, Blewett Min. Co.

Proposed by Edwin J. Collins, A. M. Plumb, D. I. Hayes.

Born 1882, Chicago, Ill. 1902-06, Michigan Col. of Mines, E. M. 1907-10, Asst. Geol. 1910-12, Min. Geol., Calumet & Arizona Min. Co. 1912-14, Examining Engr., S. W. Powell, Los Angeles, Calif. 1913-14, Min. Engr., American Smelters Security Co.

**Ralph Ballard Dimmick, Canton, O.**

Present position: Met., Berger Mfg. Co. & Stark Rolling Mill, Canton, O.

Proposed by Fred Crabtree, Haakon Styri, Charles R. Fetteke.

Born 1884, Parsons, Kans. 1902-07, Univ. of Cincinnati, B. A., M. A. 1907-09, Chem. 1909-11, Asst. Open Hearth Supt. 1911-15, Met. 1915-19, Chief Insptr. & Engr. of Tests, American Rolling Mill Co., Middletown, O.

**Ezra Stephen Dixon, Lakehurst, N. J.**

Present position: Engr., U. S. Army, Chem. Warfare Service.

Proposed by Thomas S. Roberts, Charles T. DuRell, Rush J. White.

Born 1884, Alma, Neb. 1905-10, Oregon Agricultural College, Sch. of Mines, B. Sc. 1909-12, Gen'l Min., Federal Min. & Smelt. Co., Wallace, Ida. 1913-18, Cons. & contr. wk. for self. 1917, Engr., Tucker Min. & Mill. Co., Wallace, Ida. 1918, Engr., Star Min. Co., Wallace, Ida.

**D. Gregory Donohue, Wallace, Ida.**

Present position—1916 to date: Safety & Min. Engr., Federal Min. & Smelt. Co.

Proposed by Frederick Burbridge, Stanly A. Easton, James F. McCarthy.

Born 1879, Ishpeming, Mich. 1900-03, Michigan College of Mines, B. S. & E. M. 1903-04, Min. Engr. & Chem., Illinois Iron Min. Co., North Freedom, Wis. 1904, Asst. Engr. & Geol., mine examinations, War Eagle and Center Star mines, Roseland, B. C., Canada. 1904-09, Zinc House Foreman, Bullion Melter & Assayer, La Colorado Co., La Colorado, Sonora, Mexico. 1909-12, Min. Engr., surveying, sampling, geol., Montana and Anaconda Min. Co., Butte, Mont. 1912-14, Safety Engr., Anaconda Copper Min. Co., Butte, Mont. 1914-16, Supt., Southern Cross mine of Anaconda Copper Min. Co., Southern Cross, Mont.

**James W. Dougherty, Brewster, Fla.**

Present position: Engr., Phosphate Mine.

Proposed by Edward T. Keenan, H. L. Mead, W. D. Blackmer.

Born 1883, Steubenville, O. 1904-07, Univ. of Florida. 1907-10, Member con-

tracting firm. 1910-11, Independent practice. 1911-12, Asst. in preparing plans Phosphate mine, Fla. 1912-17, Engr., Amalgamated Phosphate Co. 1917-19, Capt. Engrs., constr. wk. in France. 1919, American Cyanamid Co., Brewster, Fla.

**Clayton Cresswell Dovey, Johnstown, Pa.**

Present position—1911 to date: Gen'l Supt. of Mines, Valley Smokeless Coal Co.

Proposed by W. L. Cumings, Walter Gilman, E. F. Saxman.

Born 1880, Shenandoah, Pa. 1899, Latrobe High Sch., Pa. 1903-05, Min. Engr., Greenwich Coal & Coke Co. 1905-07, Min. Engr., Cardiff Coal Co. 1907-11, Gen'l Supt., Greenwich Coal & Coke Co. and Cardiff Coal Co.

**John Duncan, Yorkshire, England.**

Present position: Engr., Abyssinian Dev. Syndicate, London.

Proposed by A. E. Wheeler, F. W. Snow, L. A. Womble.

Born 1874, Otley, England. 1888-91, Silcoates Sch., Wakefield. 1891-94, Yorkshire College, Leeds, B. Sc. 1895-98, Apprenticed to Robert Middleton, Hydraulic Engr. Sheepscat Foundry, Leeds, England, 1898-99, Journeyman Fitter in New Zealand. 1899-03, Cutter Bros., Dredger Engrs., Dunedin, N. Z. 1903-04, Consult. wk. in Argentina. 1904-05, Consult. wk. in London. 1905-07, Dredger Designs Cutter Bros., London, E. C., England. 1907-08, Dredger design, Wilfley Co., London, E. C., England. 1909-11, Mech. Transport, Duncan Wagons, Ltd., Bradford, England. 1912-14, Wilfley Co. 1914-15, Draftsman Russo. Asiatic Corp'n. 1915-19, Engr., Union Minière du Haut Katanga, Belgian, Congo.

**William Elliott, Flat River, Mo.**

Present position: Engr., Federal Lead Co.

Proposed by E. C. Arnold, H. G. Washburn, L. G. Johnson.

Born 1890, St. James, Mo. 1907-11, Steelville High Sch., Mo. 1911-15, Missouri Sch. of Mines, B. S. in M. E. 1915-17, Asst. Engr., Federal Lead Co., Flat River, Mo. 1917-19, 1st Lieut., C. A. C., U. S. Army.

**Wilson Barton Emery, Laramie, Wyo.**

Present position: Geol., Ohio Oil Co.

Proposed by W. C. Wendenhall, M. R. Campbell, Max W. Ball.

Born 1890, Philadelphia, Pa. 1911, Yale College. 1914, Yale Univ., B. A. & Ph. D. 1914-19, Asst. & Assoc. Geol., U. S. Geol. Survey, part time Vice-Chairman, Oil Section, Land Classification Board, engaged in oil investigations in Rocky Mt. States & Okla.

**Joseph V. Emmons, Cleveland, O.**

Present position—1913 to date: Met. Engr., Cleveland Twist Drill Co.

Proposed by Henry M. Howe, Bradley Stoughton, Galen H. Clevenger.

Born 1888, North Lewisburg, O. 1905-07, Nat'l Normal Univ., Lebanon, O., A. B. 1908, Case Sch. of Applied Science. 1909-10, Special wk. in chemistry & course in metallography. 1909, Night Chem., Blast Furnace Dept., Upson Nut Co., Cleveland, O. 1909-13, Chief Chem., Cleveland Twist Drill Co.

**Daniel K. Evans, Lyon Mountain, N. Y.**

Present position—1916 to date: Min. Engr., Charge of Underground Operations, Chateaugay Ore & Iron Co.

Proposed by Thomas S. Roberts, Harry A. Baker, Howard Eckfeldt.

Born 1891, Wilkes-Barre, Pa. 1905-09, Carbondale High Sch. 1909-13, Lehigh Univ., E. M. 1914, Outside Foreman, transportation power plant, mill; 1914-16, Asst. Engr., Draftsman, Transitman, Chateaugay Ore & Iron Co.

**J. Claire Evans, Denver, Colo.**

Present position—1918 to date: Vice-Pres., Denver Fire Clay Co.

Proposed by Henry E. Wood, H. C. Parmelee, J. V. N. Dorr.

Born 1882, Zanesville, Ohio. 1897-01, Ohio Univ., A. B. 1901-03, Chem., Clear Creek Min. & Red Co., Golden, Colo. 1903-12, Chem. & Assayer, Henry Elwood Ore Testing Co., Denver, Colo. 1912-18, Dept. Mgr., Mine & Smelter Supply Co., Denver, Colo.

**Matthew Fraser Fairlie, Cobalt, Ont., Canada.**

Present position—1918 to date: Mgr., Min. Corp'n. of Canada, Ltd. & Cobalt Reduction Co.

Proposed by R. B. Watson, R. H. Lyman, J. V. N. Dorr.

Born 1880, L'Orignal, Ont., Canada. 1897, Public & Collegiate Inst. Schools,

## AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS li

**Ont., Canada.** Queens Univ., 1 yr., Arts Course & 4 yrs. Min. Engrg., B. Sc. 1902-03, Wk. on experimental section in concentrator, Boston & Mont., at Great Falls, Mont. 1903-05, Chg. of mill & Assayer, Ohio Copper Co., Bingham Canyon, Utah. 1905, Running gold mine for self, Cherry Creek, Ariz. 1906, On staff, Copper Queen, Bisbee, Ariz. 1906-08, Mill Supt., St. Louis Smelt. & Refin. Co. 1909-13, Mgr., Northern Customs Concentrators & cons. wk., Cobalt, Ont., Canada. 1913-18, Mgr., Cobalt Reduction Co., Cobalt, Ont.

**Arthur Earl Fath, Washington, D. C.**

Present position: Geol., U. S. Geol. Survey.

Proposed by M. R. Campbell, David White, Philip S. Smith.

Born 1887, Muscatine, Ia. 1906-10, Oberlin College. 1910-13, Univ. of Chicago, A. B. & A. M. 1910-12, Field Asst., summer field parties, U. S. Geol. Survey. 1913-19, Asst. Geol., Associate Geol., Geol., U. S. Geol. Survey.

**Frederic Ludwig Firebaugh, Berkeley, Calif.**

Present position: Acting Determining Mineralogist, California State Bureau of Mines.

Proposed by E. A. Hersam, Endorsed by American Electrochemical Society.

Born 1893, Austin, Tex. 1905-10, Austin High School. 1910-19, Univ. of California, College of Mines, B. S. 1916, Millman, Nevada Hills Min. Co., Nev. 1916, Asst. to U. S. Geol. Survey Statistician, San Francisco, Calif. Entered Army for Border service. 1916-17, Chainman, Indian Valley R. R. 1917, Acting Determining Mineralogist, California Bureau of Mines. 1917-18, U. S. Army. 1919, Engr., Nevada Petroleum Co.

**William Henry Fitch, Allentown, Pa.**

Present position—1916 to date: Mgr., Met. Supt., Fuller Eng. Co.

Proposed by N. S. Quigley, J. V. W. Reynders, Walter G. Perkins.

Born 1877, Bridgeport, Conn. Public Sch., Brooklyn, N. Y. 1905-12, Sales Engr., Walter Machod & Co., Cincinnati, Ohio. 1913-16, Sales Engr., Quigley Furnace & Fdy. Co., N. Y. 1909-12, Sales Engr., Rockwell Furnace Co., N. Y. 1912-13, Sales Engr., Morgan Constr. Co., Worcester, Mass.

**Benjamin Guy Flaherty, Seattle, Wash.**

Present position—1917 to date: Elec. Engr., Pacific Coast Co.

Proposed by Simon H. Ash, Henry Landes, Milnor Roberts.

Born 1885, Leavenworth, Kans. 1904, Sedro-Woolley, Wash. 1909, Univ. of Wash., B. S. & E. E. 1909-12, Elec. & Mech., N. W. I. Co., Roslyn. 1912, Line-man & Substation Constr., Stone & Webster Eng. Corp. 1912-14, Dist. operating agent, P. S. T. L. & P. Co., Summer, Wash. 1914-17, Gen'l Foreman, P. S. T. L. & P. Co., Wash.

**George H. Forrest, Anaconda, Mont.**

Present position: Met. Chem., Anaconda Cop. Min. Co.

Proposed by Enoch A. Barnard, Frederick Laist, Louis V. Bender.

Born 1891, Spokane, Wash. 1911-15, Washington State Coll., B. S. 1912-14, summers, Min. in Coeur d'Alene & Butte district. 1915-19, Testing & laboratory wk., Anaconda Cop. Min. Co.

**Samuel Frankel, New York, N. Y.**

Present position: Met., Alloys & Product, Inc.

Proposed by F. N. Flynn, Arthur L. Walker, Edward F. Kern.

Born 1893, New York, N. Y. 1912-15, School of Mines, Columbia Univ., Met. E. 1915-16, Tank House Foreman, U. S. Metals Refin. Co., Chrome, N. J. 1916, Chem., American Smelt. & Refin. Co., Maurer, N. J. 1916-18, Chem. & Met., American Smelt. & Refin. Co., Omaha, Neb. 1918, Refinery Research Chem., Cons. Min. & Smelt. Co., Trail, B. C., Canada. 1918-19, Air Service, U. S. Army.

**Walter Gammeter, Chrysotile, Ariz.**

Present position: Asst. Supt. & Engr., Arizona Asbestos Assn., H. W. Johns-Manville Co.

Proposed by A. L. McRae, Charles Y. Clayton, C. R. Forbes.

Born 1892, St. Louis, Mo. 1911-15, Missouri Sch. of Mines, B. S. 1914, Geol. field wk. 1915-16, Engr. & Asst. Mgr., Lucky Bill mine. 1916-19, Mgr., Lucky Bill mine. 1919, Engrg. dept., mill wk., sampling in mine, Burro Mt. Cop. Co., Tyrone, N. M.

**Arthur Baron Gerber, Anniston, Ala.**

Present position—1918 to date: Chief Chem., Southern Manganese Corpn.

Proposed by B. G. Klugh, J. W. Shook, Rush M. Hess.

Born 1892, Ligonier, Ind. 1910-14, Purdue Univ., B. S. in Ch. E. 1914-15, Chem., Haskell & Barker Car Co., Michigan City, Ind. 1915-17, Chem., Inland Steel Co., Indiana Harbor, Ind. 1917-18, Asst. Chief Chem., Southern Manganese Corpn., Anniston, Ala.

**John Gibson, Jr., Pittsburgh, Pa.**

Present position: Chief Engr. & Gen'l Mgr., Penn Smokeless Coal Co.

Proposed by J. R. Blackburn, Edward H. Cox, Frank Wyant.

Born 1879, Chaneyville, Md. 1893-96, Baltimore Polyt. Inst. 1896-98, Rodman, in office of Land Surveyor. 1898-1905, Transittan, Res. Engr., & Supt. of Constr., of Elec. & Steam R. R. 1905-09, Min. Engr., & Mine Supt., United Coal Co. 1909-11, Chief Engr. & Gen'l Mgr., Arctic Coal Co., Norway. 1912, Chief Engr. & Gen'l Supt., Canadian Collieries, B. C., Canada. 1912-17, Gen'l Supt. & Gen'l Mgr., United Coal Co. 1917-18, Chief Engr. & Gen'l Mgr., Pa. Smokeless Coal Co. 1918, Capt. Engrs. U. S. A.

**Harold Hutchinson Goe, Anaconda, Mont.**

Present position—1915 to date: Supt. Brick Dept., Anaconda Copper Min. Co.

Proposed by Bayard S. Morrow, Frederick Laist, Louis V. Bender.

Born 1880, Oshkosh, Wis. 1893-97, Kenyon Military Academy, Gambier, O. 1904-08, Colorado Sch. of Mines, Golden, Colo., E. Met. 1908, Anaconda Copper Min. Co. 1908-09, Dunton Gold Min. Co., Dunton, Colo. 1909-15, Eng. Dept., Test Dept., Laboratory, Anaconda Copper Min. Co., Anaconda, Mont.

**Henry William Gould, San Francisco, Calif.**

Present position—1918 to date: Gen'l Supt., Supt. & Mgr., Rutherford Mine, Rutherford Napa Co., Calif.

Proposed by Edward G. Cahill, Edwin Higgins, John Mocine.

Born 1882, Seneca, Mo. 1899-1909, Gen'l min. experience in Calif., Ore., Ariz., Nev., & Utah as Miner, Shift Boss, Foreman, Leaser & Contractor. 1909-11, Mine Supt., New Idria Quicksilver Min. Co., New Idria, Calif. 1911, Supt., Harvard Mine Inc., Jamestown, Calif. 1916, Gen'l Supt., New Idria Quicksilver Min. Co., Calif. 1917, Gen'l Supt., Sulphur Bank Assoc., Lake Co., Calif.

**Francois Grammont, Paris, France.**

Present position—1918 to date: Deputy Director, Electrolytic Copper Society.

Proposed by E. P. Mathewson, F. D. Aller, M. Altmayer.

Born 1887, Pont de Cheruy, France. 1906-09, Ecole Normale Supérieure, Licencié ès Sciences Physiques. 1909-18, Engr.; 1916, Deputy Director, Society of Porcelaines and Elect. Appliances, Grammont. 1917, Deputy Director, Society of Electrometallurgy, Grammont process.

**Sydney Alwyn Grayson, Washington, Pa.**

Present position—1911 to date: Gen'l Mgr., Jessop Steel Co.

Proposed by G. B. Waterhouse, P. W. Hatfield, and endorsed by American Iron & Steel Inst.

Born Rotherham, Yorks, England, Sheffield Tech. Sch. 1906-10, Birmingham Univ. 1901-06, Staff of Wm. Jessop & Sons, Ltd. 1906-10, Met. to E. G. Wrisley & Co., Soho, Birmingham, England. 1910-11, Asst. Gen'l Mgr., Jessop Steel Co., Washington, Pa.

**Marshall Haney, Geer, Va.**

Present position: Cons. Min. Engr.

Proposed by James T. Beard, Geo. W. Harris, Charles L. Bryden.

Born 1888, Elkton, Va. 1907-10, Shenandoah Inst. 1911-13, International Correspondence Sch. 1913-14, Bridgewater College. 1911-13, Gen'l Mgr. & Engr., Warren Copper Co. 1913-14, Engr. charge of dev. wk., American Onyx Quarry, & Virginia Quarries Co., Rockingham Co., Va. 1914-15, Engr. & Gen'l Mgr., San manganese mines. 1915-17, Constr. Engr. & Gen'l Mgr., Blue Ridge copper mines. 1917-18, Constr., Engr. & Gen'l Mgr., Cahell manganese mine. 1918-19, Constr. Engr. & Gen'l Mgr., Urlson manganese mine. 1919. Examinations and reports.

**James Ely Harding, Antofagasta, Chile, S. A.**

Present position—1918 to date: Chief Min. Engr., Andes Copper Min. Co., Potrerillos, Chile.

Proposed by Louis R. Wallace, Ira L. Greninger, A. A. Hoffman.

Born 1887, Lyme, Conn. 1899-1902, Lyme High Sch. 1902-05, Norwich Academy. 1907-09, Sheffield Scientific Sch. 1906-07, Surveyor's Helper in Mexico. 1909-11, Miner, Alaska, Canada, U. S. A., Mexico & South America. 1911-12, Drill Runner, Roosevelt Tunnel, Cripple Creek, Colo. 1912, Shift Boss, Old Yank mine, Phelps-Dodge Corp., Morenci, Ariz. 1912-13, Asst. Eng., exam. work in Mexico. 1913-14, Foreman, Mina Sta., American Smelt. & Refining Co., Francisco, Asientos, Ags., Mex. 1914-15, Shift Boss, Jack. Pt., Belcher mine, Virginia City, Nev. 1915-16, Shift Boss, Dairy Farm mine, Van Trent, Calif. 1916-17, Supt., Ojanco mines; 1917, Act. Supt., Min. Dept.; Caldera Unit; 1917-18, Exam. Engr., American Smelt. & Refin. Co.

John Victor Harvey, Matahambre, Cuba.

Present position—1916 to date: Mine Supt., Minas de Matahambre P. Pinas del Rio.

Proposed by Melvin Brugger, H. Alfred Millard, E. Fleming L'Engle.

Born 1887, Sioux City, Ia. 1907-11, Colorado Sch. of Mines, E. M. 1911, Engr. & Assayer, Buena Fe M. & M. Co., Ojuelos, Jalisco, Mexico. 1911-12, Assayer, Guanajuato Dev. Co., Guanajuato, Mexico. 1912-15, Engr., Asst. Foreman; Mill Shift Boss; Foreman & Contractor, Zinc Room Man, Peregrina mine, Guanajuato Dev. Co. 1915, Mine Supt., Mexican Milling & Transportation Co. 1916, Mine Foreman, Atlas Min. & Mill. Co., Sniffels, Colo.

Julian S. Hatcher, Springfield Armory, Mass.

Present position: Lieut.-Col., Ordnance Dept., U. S. Army.

Proposed by George K. Burgess, Paul D. Merica, Henry M. Howe.

Born 1888, Winchester, Va. 1905-09, U. S. Naval Academy, Annapolis, Md. 1913-15, 1st Lieut., Ordnance Dept., U. S. Army, Shop Officer, Watervliet Arsenal, N. Y. 1915-16, 1st Lieut. Ordnance, Student Officer in Chem. Lab., Watertown Arsenal, Mass. 1916-17, Capt., Ordnance Dept., charge of machine gun firing, Mexican Border. 1917-18, Capt. & Major, Ordnance Dept., Charge of Exper. Dept., Springfield Armory, Mass. 1918-19, Lieut.-Col. Ordnance, charge of machine gun and small arm sections, Engr. Div.

Archie Willoughby Henzell, Wilburton, Okla.

Present position: Instr. in Chem., State Sch. of Mines.

Proposed by Mead S. Johnson, George M. Brown, J. J. Rutledge.

Born 1880, Rhyl, Wales. 1893-96, Wyggeston, H. S. 1897-1901, Leicester Tech. Leicester, England. 1902, Teachers College, Borough Polytechnic, London, England. Sc. B. 1905-07, Science Teacher, in England. 1907-08, Science Teacher, Hanbury Sch., Shanghai, China. 1908-09, Instr., Univ. L'Ansore, Lokawei, Shanghai, China. 1910-12, Prof. of Science, Shantung Provincial College, Tsinanfu, N. China. 1916, Canadian Explosives, Belveil, P. Q., Canada, enlisted in C. E. F., discharged on medical survey. 1917-19, Educational Aide, Philadelphia Navy Yard. 1918, Powder & Expl. Chem., Ord. Dept., U. S. Army. Graduated from U. S. Tech. Sch., Conveys Point, N. J.

C. W. Heppenstall, Pittsburgh, Pa.

Present position: Treas. & Gen'l Mgr., C. W. Heppenstall Forge Knife Co.

Proposed by R. M. Bird, Mark A. Ammon, J. V. N. Reynders.

Born 1872, Philadelphia, Pa. Pa. State College. Started in as office boy, 1894, and now occupy the position of Treas. & Gen'l Mgr., Heppenstall Forg & Knife Co.

Walter Herd, Glace Bay, N. S., Canada.

Present position: Min. Engr., Dominion Coal Co., Ltd.

Proposed by Joseph W. Reeve, F. E. Lucas, Angus W. Macdonald.

Born 1883, Kirkcaldy, Scotland. 1895-1901, George Watson College, Edinburgh, Scotland. 1901-04, Heriot-Watt College, Edinburgh, Scotland. 1901-04, Apprenticed to Min. Engr. Heriot-Watt College, Edinburgh, Scotland. 1904-06, Asst. to Mgr., Great Western Collieries, South Wales. 1906-08, Asst. to Agent; 1908-10, Mgr., Dunniker Collieries, Kirkcaldy, Scotland. 1910-12, Dist. Mgr., United Collieries, Ltd., Glasgow, Scotland. 1912-13, Mgr., Wabana mines, Newfoundland. 1913-14, Supt., Springhill mines; 1914-16, Asst. Min. Engr., Dominion Coal Co., Ltd. 1916-19, On active service.

Richard Hughes, Cisco, Tex.

Present position: Geol., Cosden Oil & Gas Co. Tulsa, Okla.

Proposed by Jon A. Udden, Jos. T. Kupferstein, Arthur F. Truex.

Born 1889, Coal Creek, Colo. 1909-12 & 1916, Univ. of Chicago. 1909, Rodman & Recorder, U. S., G. S. topog. party. 1912-13, Detail geologic & topographic mapping in Morocco for S. Pearson & Son, London, in explor. for petroleum. 1913-15, Geol. mapping in exploration for petroleum in Algeria for S. Pearson & Son, London. 1916-18, Detail and reconnaissance geol. wk. in Kansas, Okla. & Texas Cosden Oil & Gas Co., Tulsa, Okla. 1918-19, Sub-surface geol. wk. in North Central Texas field, Cosden Oil & Gas Co.

**Albert John Huneke**, Los Angeles, Calif.

Present position: Examining Mines, Independently.

Proposed by Horace V. Winchell, C. W. Goodale, Philip Wiseman.

Born 1857, Cincinnati, O. 1882-84, Sec'y., Solid Silver Min. Co., Colorado Springs, Colo. & Silver City, New Mex. 1884-86, Exam., direct. dev. wk. and leasing mine prospects in Sonora, Mexico. 1887-90, Santa Ana Min. Co. opening up Santa Ana mine, Moctezuma District, Sonora, Mexico. 1892-93, Supt., Cumberland Min. & Smelt. Co., Castle, Mont. 1894-1903, Incorporator & Director, Western Mine Enterprise Co. and Bannack Min. & Mill. Co. 1904-07, Mine exam. and reports in Western min. states in U. S., Canada, Alaska, Mexico and Cuba. 1907-12, Supt., Tyrone Dev. Co., Tyrone, New Mex. 1912-19, Mine exam. and reports.

**Edward H. Jahn**, Clarkdale, Ariz.

Present position: Chief Draftsman, United Verde Copper Co.

Proposed by A. T. Coston, Robert E. Tally, C. R. Kunzell, Howard I. Frisbie.

Born 1884, Gonzales, Texas. 1902-06, Univ. of Texas, C. E. 1906-08, Draftsman & Transitman, S. P. Co. 1908-09, Res. Engr., Ry. Constr. with S. P. Co. 1910, Div. Engr. on Idaho Irrig. Co. Contract, Richfield, Ida., for J. G. White & Co. 1910-15, Asst. City Engr. and City Engr., Waco, Tex. 1915-16, Draftsman, Western Chemical Mfg. Co., Denver, Colo. 1916 to date, Draftsman, Asst. Ch. Draftsman & Chief Draftsman, United Verde Copper Co.

**Frank Henry Jones**, Clarkdale, Ariz.

Present position—1919 to date: Designing Draftsman, United Verde Copper Co.

Proposed by A. T. Coston, Robert E. Tally, C. R. Kuzell.

Born 1866, Galveston, Tex. 1894-98, Colorado Sch. of Mines, E. M. 1905-07, Des. Draftsman & Constr. Engr., Nevada Cons. Cop. Co. 1915-16, Gen'l Supt., American Coal Refin. Co. 1917-18, Des. Draftsman, St. Joseph Lead Co.

**Charles Kleinman**, Toledo, Ohio.

Present position—1917 to date: Met., Doehler Die Casting Co., Toledo, Ohio.

Proposed by H. H. Doehler, Charles Pack, G. H. Clamer.

Born 1884, Russia. High Sch. of Russia, Cooper Union, New York, N. Y., B. C. 1911-17, Chief Chem., Lederle Labs., N. Y.

**Carleton Spayth Koch**, Wilksburg, Pa.

Present position—1906 to date: Pres. & Gen'l Mgr., Fort Pitt Steel Casting Co., McKeesport, Pa.

Proposed by A. H. Jameson, W. D. Sargent, Bradley Stoughton.

Born 1875, Buffalo, N. Y. 1894-98, Mass. Inst. of Tech., B. S. 1898-99, Instr. Met., M. I. T. 1899-1901, Supt. Fdry., Wm. Sellers Co., Inc., Philadelphia, Pa. 1901-03, Asst. Mgr., American Radiator Co. 1903-06, Mgr., American Steel Foundries.

**Hans Landolt**, Turgi, Switzerland.

Present position—1897 to date: Mngng. Director, Electrochem. Wks.

Endorsed by American Electrochem. Society.

Born 1869, Zurich, Switzerland. 1887-92, Eidgenossische Polytechnische Hochschule. 1892-95, Chem. Fabrik Kalk, near Kologne, Germany. 1895-97, Société Chimique des Usines du Rhone, St Fons les Lyons, France.

**Oscar James Langendorf**, Kellogg, Ida.

Present position—1919 to date: Mill Foreman, Bunker Hill & Sullivan Min. & Con. Co.

Proposed by Stanly A. Easton, Royal S. Handy, Ethelbert Haug.

Born 1882, Jefferson Co., Pa. Pub. Sch., Lisbon, Ohio. 1898, 2 yrs. High Sch. 1899-1902, Machinist, Hidalgo Min. Co. 1902-03, Asst. Master Mech., Penoles Min. Co. 1903-06, Master Mech., Panal Mill. Co. 1906-08, Master Mech., El Rayo Min. & Dev. Co. 1908-11, Mill Supt., Mexico Cons. Min. & Smelt. Co. 1911-14, Mill Supt., Alvarado Min. & Mill. Co. 1914-17, Master Mech., Commercial Min. Co. 1917-18, Mill Supt., Nat'l Cop. Min. Co. 1918-19, Mill Supt., Mullan Mill. Co.

## AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS IV

**James Alfred Lannon**, Pueblo, Colo.

Present position—1915 to date: Mine Supt., Gen'l Supt. with duties of Mgr., Atlas M. & M. Co., Sneffels, Colo.

Proposed by Donald Dyrenforth, James E. Dick, John J. Cadot.

Born 1886, Evanston, Wyo. 1906-07, Univ. of Colo. 1907-11, Colo. Sch. of Mines, E. M. 1911-12, Engr. Assayer, Accountant, Midas Gold Min. Co., Knob, Calif. 1912-14, Lannon & Merrill, Contractors, Los Angeles, Calif. 1914-15, Mill and Mine Foreman, Mexican Candelaria Co., San Dimas, Dgo, Mexico.

**Bertus P. Larkin**, Benton, Wis.

Present position—1918 to date: Mgr., Lawrence Mines Co.

Proposed by C. E. Musselman, R. J. St. Germain, R. E. Davis.

Born 1881, Hazel Green, Wis. 1895-99, Hazel Green High Sch. 1914-17, Correspondence School. 1914-15, Supt., Prospect Drilling. 1915-16, Supt. and Surveying. 1916-18, Mine Supt., Supt. and Surveying; Prospect Drilling, both Cleveland Min. Co. and Lawrence Mines Co.

**Johan Albert Leffler**, Bergshogshodan, Stockholm, Sweden.

Present position—1918 to date: Prof. of Met. of Iron, Royal Tech. Univ., Stockholm.

Proposed by Joseph W. Richards, K. F. Goransson, Walfr Peterson.

Born 1870, Goteborg, Sweden. College grad. 1900-05, Chief Engr. & Mgr., Kloaters Aktiebolag, Sweden. 1905-16, Met. Engr., Jernkontoret, Stockholm. 1917-18, Tech. Mgr., Director, Dannemora Wks.

**Samuel Colville Lind**, Golden, Colo.

Present position—1918 to date: Physical Chem. & Supt., Golden Sta., U. S. Bureau of Mines.

Proposed by H. W. Young, William H. Coghill, R. B. Moore.

Born 1879, McMinnville, Tenn. 1895-1900, Washington & Lee Univ. 1900-02, Mass. Inst. of Tech. 1903-05, Univ. of Leipzig. 1910-11, Univ. of Paris, A. B., B. S., Ph. D. 1902-03, Asst. Analytical Lab., Mass. Inst. of Tech. 1903-05, Dalton Traveling Fellow, M. I. T. 1905-10, Instructor in Geol. & Phys. Chem., Univ. of Mich. 1911-13, Asst. Prof. of Geol. & Phys. Chem., Univ. of Mich. 1913-18, Asst. Chem., & Chem. in Radioactivity, U. S. Bureau of Mines.

**Ching Fang Liu**, Tientsin, China.

Present position—1918 to date: Mine Supt., Tching Wha Coal Min. Co., Tatung, China.

Proposed by Kwong Yung Kwang, Yang Tsang Woo, John P. Kenrick.

Born 1885, Burma, China. 1905-09, Calcutta Univ. 1909-12, Royal Sch. of Mines, Imperial College of Science & Tech., London, A. R. S. M., D. I. C., B. A. 1912-13, Explor. Engr. to Li Yuan Hung, Vice Pres. & later Pres., Republic of China. 1913, Lecturer in min., Shafsi Tech. College, Taiyuanfu, China. 1913-15, Chief Tech. Dept., Natl. Oil Admin. of Republic of China. 1916-17, Asst. Engr., Dept. of Surveying, Messrs. Siems Carly Railway Co.

**Russell E. Lowe**, Rumford, Me.

Present position: Works, Mgr., Maine Power Sales Co.,

Proposed by E. E. Bugbee, Endorsed by American Electrochemical Society.

Born 1891, New York, N. Y. 1905-09, Horace Mann School. 1909-13, Union College. 1913-16, Mass Inst. Tech., B. E. & S. B. 1916-18, Chief Chem., Fitz Gerald Labs. Inc., Niagara Falls, N. Y. 1918-19, Wks. Mgr., and Electrometallurgist, Maine Power Sales Co.

**Edward Gardfield Mahin**, Lafayette, Ind.

Present position—1914 to date: Prof. Analytical Chem., Purdue Univ.

Proposed by W. M. Corse, F. L. Wolf, L. W. Olson.

Born 1876, Lafayette, Ind. 1897-1901, Purdue Univ. 1903-03, Johns Hopkins Univ., B. S., M. S., Ph. D. 1901-03, Asst. in Chem.; 1903-06, Instructor; 1908-14, Asso.; 1914 to date, Prof. of Chem., Purdue Univ.

**Michael Joseph McAndrew**, Clarksburg, W. Va.

Present position: Min. Engr., J. H. Weaver & Co., Philadelphia, Pa.

Proposed by Frank Haas, E. B. Moore, Franklin K. Day.

Born 1891, Clarksburg, W. Va. 1911, Grad., Clarksburg High Sch. 1910-13, Chainman. 1913-18, Transitman doing all kinds of engrg. wk., Consolidated Coal Co., Clarksburg, W. Va. 1918-19, Engr. in Q. M. C., U. S. Army.

**David Ford McCormick**, San Antonio, Tex.

Present position—1915 to date: Chief Engr., Minas Matahambre, Prov., Pinas del Rio, Cuba.

Proposed by E. Fleming L'Engle, H. Alfred Millard, Martin J. Heller.

Born 1887, Del Rio, Tex. 1903-05, San Antonio High Sch. 1905-08, Univ. of Texas. 1908-10, Colorado Sch. of Mines, C. E., E. M. 1909, Instrumentman, Government Reclamation Survey, Colo. 1910, Instrumentman, R. R. Location, South Texas. 1910-12, Cyanide concent. all jobs to Foreman, Mine Surveyor, Timberman, Contr. Engr. Power Plant, etc. 1912-15, Engr., Mine Supt., Mill Supt., Asst. Mgr., Aquacate Mines.

**Forrest Millan McDaniel**, Clarksburg, W. Va.

Present position—1913 to date: Min. Engr., J. H. Weaver & Co., Philadelphia, Pa.

Proposed by Frank Haas, E. B. Moore, Franklin K. Day.

Born 1889, near Grafton, W. Va. 1907, Grad., Kingwood High Sch., Kingwood, W. Va. 1908-09, West Virginia Univ., Morgantown, W. Va. 1909-10, Chairman for Consolidation Coal Co., Fairmont, W. Va. 1910-13, Transitman for Consolidation Coal Co., Clarksburg, W. Va.

**Guy Raymond McKay**, Park City, Utah.

Present position—1918 to date: Supt., Daly West Mine.

Proposed by George S. Krueger, O. N. Friendly, George D. Blood.

Born 1883, St. Thomas, No. Dak. 1899-1902, Pembina, N. D., High Sch. 1904-09, No. Dak. Univ. & Sch. of Mines, E. M. 1909-10, Mucker Tramway Operator, Laborer, Kitty Burton mine, Ulysses, Ida. 1910-11, Miner. 1911-12, Asst. Engr., 1912-18, Engr. for Daly Judge Min. Co., Park City, Utah, also Snake Creek Min. & Tunnel Co.

**George Francis McMahon**, Chicago, Ill.

Present position—1916 to date: Electrochem., Western Electric Co., Inc.

Proposed by Francis R. Pyne, W. C. Smith, J. W. Harris.

Born 1890, Burlington, Vt. 1908-12, Univ. of Vt., B. S. in Ch. 1912-13, Analytical Chem., Grasselli Chem. Co. 1913, Analytical Chem., Hartford Lab. Co. 1914-16, Research Chem., U. S. Metals Refin. Co.

**Frederick Storres McNicholas**, Golden, Colo.

Present position: Shift Boss, Timber Butte Mill. Co., Butte, Mont.

Proposed by T. C. Wilson, D. W. Buckby, Geo. O. Deshler.

Born 1888, Durango, Colo. 1914, Colorado Sch. of Mines, E. M. 1907-08, Miner, May Day Gold Min. Co. 1908-09, Miner, Tomahawk Mines Co. 1909-14, Summers, and part of 1912 as miner with above companies. 1914-16, Asst. Flotation Foreman, Timber Butte Mill. Co. 1916-18, Mngng. Engr., Buena Vista Min. Co. 1918-19, Exam. Engr., Marshall & Keith, Cuba.

**Earle Yancey McVey**, Cannelton, W. Va.

Present position—1918 to date: Asst. Supt., Cannelton Coal & Coke Co.

Proposed by Guy B. Hartley, E. B. Roeser, Walter Greig Crichton.

Born 1887, Victor, W. Va. 1905-08, Montgomery Prep. Sch. 1908-10, West Virginia Univ. 1910-12, Ohio Northern Univ., C. E. 1912-14, Private practice, County Surveyor, Fayette Co., W. Va. Min. Engr., Cannelton Coal & Coke Co. 1914-16, Min. Engr., Philip Konrad, Kanawha Falls, W. Va. 1916-17, Min. Engr., Black Betsey Cons. Coal Co., Kimberly, W. Va. 1917-18, Engr., Cannelton Coal & Coke Co., Cannelton, W. Va.

**Helon B. MacFarland**, Chicago, Ill.

Present position—1909 to date: Engr. Tests, Atchinson, Topeka and Santa Fe Railway System.

Proposed by George M. Davidson, C. W. Gennet, Jr., J. de N. Macomb.

Born 1869, Trenton, Me. 1891-94, Worcester Polytech. Inst. 1902-03, Cornell Univ., B. S. 1894-96, Headmaster, Canaan Academy, Canaan, Conn. 1896-98, Principal, Housatonic Valley Inst., Cornwall, Conn. 1898-99, Principal, Newton Academy, Newton, Conn. 1900-02, Director Man. Train., State Normal College, Florence, Ala. 1903, Special Engr., Lorain Steel Co. 1903-08, Prof. Applied Mechanics & Thermodynamics, Armour Inst. Tech., Chicago, Ill. 1904-08, Editor, *Gas Power*, St. Joe, Mich. 1905-08, Cons. Engr., Acme Gas Co. 1906-07, Cons. Engr., Int. Gas Producer Co. 1908-09, Cons. Engr., general practice.

**Thomas George Mackenzie, El Paso, Tex.**

Present position—1918 to date: Gen'l Mgr., Cia Minera de San Patricio, Parral, Chic., Mexico.

Proposed by R. G. Dufoureaq, W. S. Harrison, A. Kennedy Macfarlane.

Born 1882, River John, N. S., Canada. 1888-97, Common Sch. 1897-00, High Sch. 1900-06, Dalhousie College, Halifax, N. S., Canada, B. E. 1906-10, Charge Engrg. Dept., Nova Scotia Steel & Coal Co., Wabana, Newfoundland. 1910-11, Gen'l Mgr., North Atlantic Collieries, Port Marien, N. S., Canada. 1911-14, Examinations at Parral, Chih., Mexico, and Mgr. San Patricio property. 1914 to date, Gen'l Mgr., Cia Agricola y de Fuerza Electrica del Rio Conchos, La Boguilla & Parral, Chih., Mexico.

**William Mackenzie, Santa Paula, Calif.**

Present position: Mngng. Director, Ben Ezra Copper & Gold Min. & Smelt. Co.

Proposed by T. H. Jenks, Leonard D. Sivyer, Richard A. Perez.

Born 1862, Hawkesbury, Ont., Canada. 1870-76, Educated Aberdeen, Scotland. 1910-19, Mgr., Ben Ezra Copper & Gold Min. & Smelt. Co., employing from three to ten men over 2000 ft. of development wk. with shipment of ore, etc. Property located in Eldorado min. dist., Nev.

**Charles Hodge MacMillan, Limerick, Me.**

Present position—1913 to date: Cons. Engr.

Proposed by H. S. Gulick, R. A. Bull, E. R. Swanson, Bradley Stoughton.

Born 1869, Peoria, Ill. 1887-90, Princeton Col. 1901-04, Supt., Steel Foundry, British Westinghouse Co. 1904-05, Supt. Steel Plant, Tennessee Coal & Iron Co. 1906-13, Gen'l Supt., Dominion Steel Corpn.

**Lolá Charles Mazzola, Jersey City, N. J.**

Present position—1918 to date: Asst. Supt., The Metal & Thermit Corpn.

Proposed by H. G. Spilsbury, E. A. Beck, Fred W. Cohen.

Born 1892, Saint Joseph, Mo. 1908-12, Manhattan Prep. School. 1912-17, Cooper Inst., B. Sc. 1913-14, Asst. Chem., Cornell Univ. Medical College. 1914-15, Asst. Chem., Ricketts & Co., Inc., New York, N. Y. 1915-16, Asst. Chem. Research Wk., Standard Oil Co., Kingsland and Greenpoint ores, Greenpoint, L. I. 1916-17, Treasurer, Dexola Chem. Co., Bronx, N. Y. 1917-18, Met. in charge of Babbitting Dept., Wright Martin Aircraft Corpn.

**Bernard Pierre Miller, New York, N. Y.**

Present position: Just out of Military Service.

Proposed by Richard A. Parker, J. F. B. Erdlets, Jr., Roger W. Straus.

Born 1879, Paris, France. 1900-05, Ecole des Mines, E. M. 1905, Asst. to Mine Supt., Weardale Lead Co., & Assn. to Supt. of Mill, Neuthead Zinc Co., England. 1906-7, Supt. Las Animas mine, Altar Syndicate, Mexico. 1908-10, Private prac., mine exam. Nev. & Cal. 1910-11, Mgr., Knickerbocker Mines Co., & Ariz. Cop.-Gold Mine & 15-stamp mill. 1912-13, Supt., Big Pine mine, Standard Expl. Co., Denver, Colo. 1913-15, Cons. Engr. 1915-16, Mgr., placer mine (For H. W. Manning). 1917-19, Capt. Engrs., U. S. Army.

**David Edwin Morrow, Birmingham, Ala.**

Present position—1917 to date: Min. Engr., Semet Solvay Co., Ensley, Ala.

Proposed by Anson W. Allen, K. Landgrebe, A. F. Hilleke.

Born 1866, Hartsell, Ala. Hartsell High Sch. 1894-04, Res. Min. Engr. & Supt. of Coal Mines, Sloss Sheffield Steel & Iron Co. 1904-11, Gen'l Supt. Mines, Alabama Consolidated Coal & Iron Co., Tuscaloosa County, Ala. \* 1911-12, Supt. Mines, Alabama Fuel & Iron Co., Acton, Ala. 1912-17, Engr. Supt. of Mines, Yalande Coal & Coke Co.

**William August Mueller, Columbus, O.**

Present position: Research & Cons. Wk., Met. & Gas Problems.

Proposed by D. J. Demorest, H. E. Nold, William J. McCaughey.

Born 1889, Cincinnati, O. 1907-11, Ohio State Univ., Sch. of Mines. 1911, Chem., Oliver Iron Min. Co., Hibbing, Minn. 1911-12, Millman & Chem., Detroit Copper Min. Co., Morenci, Ariz. 1912-13, Jr. Chem., U. S. Bureau of Mines, Washington, D. C., & Pittsburgh, Pa. 1913, Chief Chem., Ricketts and Banks, New York, N. Y.; Assayer, American Platinum Wks., Newark, N. J. 1913-14, Jr. Chem., U. S. Bureau of Mines, Pittsburgh, Pa. 1914-15, Chem., Inspiration Cons. Copper Co., Miami, Ariz. 1915-18, Met., Gen'l Engrg. Co., Salt Lake City, Utah. 1918-19, Capt., Chemical Warfare Service, U. S. Army. 1919, Mine Engr., Southern Gypsum Co., Inc., North Holston, Va.

**Neil Neville, Philadelphia, Pa.**

Present position—1918 to date: Met. & Asst. to Vice-Pres., Electric Furnace Constr. Co.

Proposed by Wm. F. Prouty, Eugene A. Smith, A. L. Marsh.

Born 1892, Ottumwa, Ia. 1907-11, Birmingham High Sch. 1911-15, Univ. of Ala., B. S. in M. E. 1915-16, Geol. & Chem., State Geol. Survey of Ala. 1916, Chem., U. S. Bureau of Mines, Washington, D. C. 1916-17, Met., Anniston Steel Co., Anniston, Ala. 1917-18, Met., British Forgings, Ltd., Toronto, Canada.

**Charles McIlvaine Nicholson, Wallace, Idaho.**

Present position: Private business.

Proposed by L. K. Armstrong, J. C. Garvin, J. McD. Porter.

Born 1878, Sodas, N. Y. 1894, Com. Sch. 1894-1903, Gen'l Undergrd. Exp., Cripple Creek, Colo. 1909-10, Chg. Development, Alaska Iron Co., Rainy Hollow, B. C., Canada. 1911-12, Mine Supt., Mineral Creek Min. Co., Valdez, Alaska. 1915-16, Mine Supt., Little Pittsberg Min. Co., Wallace, Ida. 1918-19, Field Engr., Wyo.-Mont. Co., Billings, Mont.

**Henning Ekstrom Olund, Vidal, Calif.**

Present position: Min. Engr. & Gen'l Supt., American Eagle Cons. Mines Co., New York, N. Y.

Proposed by W. R. Appleby, Anton C. Orberg, Charles E. Van Barneveld.

Born 1884, Hudson, Wis. 1902-07, School of Mines, Univ. of Minn., E. M. 1909-12, Min. Engr. & Gen'l Supt., Lake Superior & Nevada Dev. Co. 1912-17, Engr. & Supt., Calzona Mines Co., Vidal, Calif. 1917-19, Private practice, as Cons. Engr., mine examination wk.

**Walter C. Page, Portola, Calif.**

Present position—1919 to date: Mill Foreman, Walker Min. Co.

Proposed by V. A. Hart, O. M. Kuchs, A. B. Young.

Born 1891, Syracuse, Neb. 1910, Univ. of Colorado. 1911-15, Colorado School of Mines, E. M. 1912-15, Summers, Survey Asst., U. S. R. S., Grand Valley Project, Colo. 1915-17, Testing & Research Depts., International Smelt. Co., Tooele, Utah. 1917, Flotation Foreman, Walker Min. Co., Portola, Calif. 1917-18, 1st Lieut., 20th Infantry. 1918-19, 1st Lieut., Infantry Air Service, U. S. Army.

**Sverre Petersen, St. Louis, Mo.**

Present position—1918 to date: Head of Technical Dept. 4, Roxana Petroleum Co.

Proposed by R. A. Conkling, Earl Oliver, Grady Kirby.

Born 1882, Fredrikshald, Norway. 1902, Tech. Col., Bergen, Norway, M. E., 1902-04, Draftsman, R. D. Wood Co., Camden, N. J. 1904-07, Designer & Checker, Allis-Chalmers Mfg. Co. 1907-08, Designer, Bucyrus Co. 1908-10, Asst. Chief Engr., Bethlehem Steel Co. 1910-12, Chief Draftsman, Allis-Chalmers. 1912-14, Engr., H. R. Worthington. 1914-18, Chief Engr., Lucey Mfg. Corpn.

**Harry D. Quinby, Chewelah, Wash.**

Present position—1918 to date: Mine Supt., Canada Copper Corpn., Ltd., Greenwood, B. C., Canada.

Proposed by Oscar Lachmund, Henry Landes, L. K. Armstrong.

Born 1864, St. Louis, Mo. 1883-84, Rolla Sch. of Mines & Met. 1898-00, Mgr., Independence Min. & Mill. Co. 1900-03, Mgr., Desloge Cons. Lead Co., Desloge, Mo. 1905-07, Mgr., Western Ore Separating Co., Salt Lake City, Utah. 1907-08, Met., American Zinc Lead & Smelt. Co., Boston, Mass. 1908-09, Ore Testing in Canon City, and Denver, Colo. 1909-13, Mgr. various small properties in United States and Canada. 1913-14, Act. Mgr., Jewel Denoro Mines, Ltd., Greenwood, B. C., Canada. 1915, Field Engr., Canada Copper Corpn., Ltd., Greenwood, B. C., Canada. 1916, Field and Examining Engr., Embree Iron Co., Embreeville, Tenn.; and Wisconsin Explor. Co., Linden, Wis.

**Leopold Reinecke, Ottawa, Canada.**

Present position—1918 to date: Geol., Geological Survey of Canada.

Proposed by John A. Dresser, Frank D. Adams, W. G. Miller.

Born 1884, Ares, Cape Colony. 1899-1902, Univ. of Cape of Good Hope. 1903-08, Cornell Univ. 1912-14, Yale Univ., B. A., M. A. 1908-10, Topographer, Geological Survey, Canada. 1911-13, Junior Geol., Geological Survey, Canada. 1914-17, Geol. in charge of Road Materials Div., Geol. Survey.

## AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS lix

**Nicholas Berthond Ringeling**, Philipsburg, Mont.

Present position: U. S. Mineral Surveyor, Mine Operator, Assayer.

Proposed by Samuel Barker, Jr., John Gillie, C. W. Goodale.

Born 1849, St. Louis, Mo. 1864-66 and 1871-73, Washington Univ. & Poly., Stuttgart, Wurtemberg, Germany. 1873-74, Asst. Engr., Ranny Powell, St. Louis, Mo. 1874-75, Asst. Engr., Ohio & Mississippi R. R. 1875-80, Asst. Secy. & Engr., Assayer, Millman, Asst. Supt., Hope Min. Co., Davis mines, Colusa Co., Colusa Parrot, Ramsdell Parrot, Parrot Co. mines. 1890-99, Engr. Supt., Hope Min. Co., St. Louis, at Philipsburg, Mont., Constr. Engr., Paine Co.

**Henry Preston Roe**, Port Colborne, Ont., Canada.

Present position—1918 to date: Dept. Supt., International Nickel Co. of Canada, Ltd.

Proposed by John More, James T. Kemp, O. B. J. Fraser.

Born 1890, Brooklyn, N. Y. 1905-08, Freeport High Sch. 1917, Columbia Univ., New York, N. Y. 1908-09, File Clerk, Auditor's office, Long Island R. R. Co., New York, N. Y. 1909-10, Clerk in Windsor Print Works, New York, N. Y. 1910-18, In office; on cop. converters; mechanical calcimining furnaces; Foreman in nickel calcimining dept.; Gen'l Foreman, International Nickel Co., Bayonne, N. J.

**John Dwight Rogers**, Big Stone Gap, Va.

Present position—1917 to date: Chief Engr., Stonega Coke & Coal Co.

Proposed by R. V. Norris, Howard S. Estill, Howard N. Eavenson.

Born 1879, Remsenburg, N. Y. 1899-1903, Lehigh Univ., C. E. 1903-04, Rodman & Transitman, B. & O. R. R. 1904-05, Transitman & gen'l office man on coke oven construction, W. G. Wilkins Co., Pittsburgh, Pa. 1905-14, Office man & Div. Engr.; Chief Engr., Miller's Creek Div.; Gen'l Supt., Miller's Creek Div., Consolidation Coal Co., Fairmont, W. Va. 1915-17, Chief Mine Inspector & Plant Supt., Stonega Coke & Coal Co., Big Stone Gap, Va.

**Luke Eugene Sawyer**, Bayonne, N. J.

Present position—1911 to date: Tech. Met. & Production Engr., Babcock & Wilcox Co., Beaver Falls, Pa.

Proposed by D. S. Jacobus, Isaac Harter, Henry M. Howe.

Born 1887, Malden, Mass. 1906-10, Mass. Inst. of Tech., S. B. 1910-11, Asst., Steam Eng. Lab., Mass. Inst. Tech.

**Martin H. Schmid**, Canton, O.

Present position—1913 to date: Met. Engr., United Alloy Steel Corpn.

Proposed by A. A. Stevenson, Lawford H. Fry, Orville Campbell Skinner, C. F. W. Rye.

Born 1885, Washington, D. C. 1903-07, Lehigh Univ., M. E. 1907-09, Mech. & Exper. Dept., Corn Products Co. 1909-13, Mech. Engr., United Alloy Steel Corpn.

**Harry Scott**, London, Ariz.

Present position—1908-19: Supt., London Arizona Cons. Copper Co.

Proposed by H. F. Easter, E. R. Marble, William T. MacDonald.

Born Scotland. 1876, Rugby. 1878, St. Andrews. 1881, St. John's, Ox. 1885, Victoria Univ., B. A., M. D., & L. C. 1890-95, Prospected, mined & located. 1896-1901, Assayed and prospected in Cripple Creek, and San Juan. 1902-05, Prospected and examined properties. 1905-06, Managed Grunwater Copper Co.

**Edwin Kimmonth Smith**, Milwaukee, Wis.

Present position—1918 to date: Met., Wisconsin Malleable Iron Co.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1884, Newark, N. J. 1900-03, St. Paul's Sch. 1903-08, Sheffield, Yale, Ph. B. 1908-09, Chem., New York Insulated Wire Co., Wallingford, Conn. 1909-10, Chem., Wisconsin Malleable Iron Co., Milwaukee, Wis. 1910-15, Chief Chem., Naugatuck Malleable Iron Co., Naugatuck, Conn. 1915-18, Mgr., Brass Fixtures Co., Plantsville, Conn.

**Russell John Spry**, Eustis, Que., Canada.

Present position—1915 to date: Asst. Supt., Eustis Min. Co.

Proposed by W. E. C. Eustis, Frederic Keefer, H. E. T. Haultain.

Born 1888, London, Ont., Canada. Univ. of Toronto, B. A. Sc. 1909, summer, O'Brien mine, Cobalt, Ont., Canada. 1910-14, Assayer, Met., Engr. & Mine Supt., British Columbia Copper Co.

**Thomas Driver Stockdale, Hasleton, Pa.**

Present position—1917 to date: Master Mech., Cranberry Creek Coal Co.

Proposed by J. B. Warriner, Edwin Ludlow, H. W. Montz.

Born 1875, Morley Yorks, England. 1886-95, Leeds Higher Grade. 1895-97, Yorkshire College, Leeds, England. 1910-13, Mech. & Elec. Engr., McGillvray Creek Coal & Coke Co., Coleman, Alta., Canada. 1913-14, Mech. Engr., Leitch Collieries, Passburg, Alta., Canada. 1915-17, Master Mech. & Elec. Engr., Jasper Park Collieries, Pocahontas, Alta., Canada.

**William Taylor Thom, Jr., Washington, D. C.**

Present position: Geol., U. S. Geol. Survey.

Proposed by Joseph Kent Roberts, Frank A. Wilder, Clarence E. Garland.

Born 1891, Roanoke, Va. 1910-13, Washington & Lee Univ. 1913-17, Johns Hopkins Univ., B. D., Ph. D. 1912-16, Rodman, Geol. Aid, and Asst. Geol., U. S. Geol. Survey field party. 1916-17, Dept. Fellow and Lab. Asst. in Geol., Johns Hopkins Univ. 1917-19, Assoc. Geol. directing statistical investigations for committee on coal production of Council of Defense. 1919, Geol. charge of field party, examining coal resources and rock structures, McCone County, Mont.

**Charles Weldon Tomlinson, Denver, Colo.**

Present position—1918 to date: Geol., Gypsy Oil Co., Rocky Mt. States.

Proposed by A. N. Winchell, W. J. Mead, Stephen Royce.

Born 1892, Detroit, Mich. 1909-14, Univ. of Wis. 1914-15, Univ. of Minn. 1915-16, Univ. of Chicago, B. A., M. A., Ph. D. 1910, Camp hand; 1911, Field Asst., U. S. Geol. Survey. 1912, Compassman, E. J. Longyear Co. 1913, Asst. Geol., Pfister & Vogel Co., Milwaukee, Wis. 1914, Research Asst., Univ. of Wis.; Asst. Geol., E. J. Longyear Co. 1914-15, Asst. Geol., Univ. of Minn. 1915-16, Field Geol., Carter Oil Co., Kans. 1916-17, Prof. of Geol., Mississippi Agricultural & Mech. College. 1917, Geol., Oil Exploration, J. B. Schermerhorn. 1917-18, Asst. Geol., Univ. of Ill.

**Alfred Joseph Tonge, Sydney, N. S., Canada.**

Present position—1918 to date: Gen'l Supt., Dominion Coal Co., Ltd.

Proposed by Joseph W. Revere, F. E. Lucas, Angus W. Macdonald.

Born 1868, Over Halton, Bolton, England. 1879-85, Bolton High Sch. 1886-93, Chief Surveyor, Halton Colliery Co., Bolton, England. 1893-1912, Gen'l Mgr., Halton Collieries. 1912-17, Chief Min. Engr.; 1917-18, Gen'l Supt., of Mines, Dominion Coal Co., Ltd., Glace Bay, Canada.

**Ronald V. A. Waldron, Lorado, W. Va.**

Present position—1918 to date: Supt. 3-Forks Coal Co.

Proposed by William Blake Crawford, John Stewart, George M. Jones.

Born 1886, Grundy, Va. Grundy High Sch. 1910-12, Min. Engr., Va. Pocahontas Coal Co., Coalwood, W. Va. 1912-17, Mine Supt., Va. Buffalo Coal, Bracholm, W. Va. 1917-18, Mgr. & Engr., Sterling Block Coal Co., Altman, W. Va.

**Joseph William Walton, Tul-Mi-Chung, Chosen, Korea.**

Present position—1916 to date: Mine Foreman, Seoul Min. Co.

Proposed by J. Mitchell-Roberts, Alexander McFarlane, Walter W. Barnett.

Born 1884, Dalton, England. 1897, Grammar Sch., Ishpeming, Mich. 1900-10, Trammer, Trackman, Timberman, and Miner, Cleveland Cliffs Iron Co., Ishpeming, Mich. 1910-12, Oliver Iron Min. Co., Ishpeming, Mich. 1912-13, Miner, Cleveland Cliffs Iron Co., Ishpeming, Mich. 1914-16, Shift Boss, Seoul Min. Co.

**Arthur George Skinner Watt, Franklin, N. J.**

Present position—1915 to date: Asst. Mine Foreman, New Jersey Zinc Co.

Proposed by Robert H. Seip, Clarence M. Haight, Gilbert L. Morse.

Born 1885, Burnside, Scotland. 1907-15, Engrg. Dept. New Jersey Zinc Co.

**Paul Ashley West, Toledo, Ohio.**

Present position: Chem. to Research Laboratories Co.

Endorsed by American Electrochemical Society.

Born 1892, Leipsic, Germany. 1908-12, Kenyon College. 1913, Oberlin. 1913-15, John Hopkins Univ., A. B., A. M. 1917, Instructor Chem., Delphos, Ohio. 1917-19, Instructor Chem., Scott High School, Toledo, Ohio.

**Elgin Roscoe Wilcox, Seattle, Wash.**

Present position: Supt., John T. Towers.

Proposed by F. K. Ovitiz, William H. Coghill, Milnor Roberts.

Born 1892, Seattle, Wash. 1911-15, Univ. of Washington, B. S. & Met. E. 1913-

14, Transitman, Engr. Staff, Perseverance mine, Juneau, Alaska. 1915, Engr., Overlook Min. & Dev. Co., Atlanta, Ida. 1916-17, Mine and mill wk., Butte Superior Min. Co. 1917, Supt., Big Thing mine, Ladysmith Smelt. Co., Seattle, Wash. 1917-18, Assayer & Engr., Venus mine, Carcross, Y. T., Canada. 1918-19, Fellowship with Univ. of Washington, College of Mines, and U. S. Bureau of Mines, Seattle, Wash.

**Burnett Pierson Wiley**, Buffalo, N. Y.

Present position—1918 to date: Supt. Open-hearth Dept., Lackawanna Steel Co., Lackawanna, N. Y.

Proposed by A. C. Parsons, A. H. Lee, G. B. Waterhouse.

Born 1890, Chicago, Ill. 1908, Grad. Wendell Phillips High Sch., Chicago, Ill. 1909-10, Chem.; 1910-12, Operating Open-hearth furnace, at No. 1 Open-hearth Dept.; 1917-18, Foreman of No. 1 Open-hearth Dept., Lackawanna Steel Co., Lackawanna, N. Y.

**Sanford Lawton Willis**, Washington, D. C.

Present position: Special Agt., U. S. Tariff Commission.

Proposed by G. C. Riddell, Toner Antisell, Edson S. Bastin.

Born 1892, Boston, Mass. 1911-15, Mass. Inst. of Tech., S. B. 1915-16, Charge of sampling and Asst. Chem., American Zinc Co. of Tenn., Mascot, Tenn. 1916, Chem., Eustis Min. Co., Eustis, P. Q., Canada. 1916-17, Plant Met. & Testing Engr., General Filtration Co., Rochester, N. Y. 1917-19, Plant Met., American Zinc Co., Ill., Asst. Supt. oxide plant.

**James Z. Zimmerman**, Delmont, Pa.

Present position: Vice Pres., Comanche Petroleum Co.; Cons. Geol., C. H. Pforzheimer & Co.

Proposed by H. B. Meller, Robert M. Black, Horatio C. Ray.

Born 1887, Delmont, Pa. 1908-11, Univ. of Pittsburgh, B. S. 1912-13, Gen'l office wk., Peoples Nat. Gas Co. 1913-16, Instr. in Min., Univ. of Pittsburgh. 1916-17, Oil Geol., Johnson & Huntley. 1917-18, Cons. Oil Geol., Benedum-Trees. 1918, Carl H. Pforzheimer & Co.

### Associates

**John Ward Amberg**, Chicago, Ill.

Present position: Pres., of Loretto Iron Co.

Proposed by C. H. Barter, William Kelly, O. C. Davidson.

Born 1870, Chicago, Ill. St. Ignatius College, Chicago, Ill. 1901 to date, Gen'l Mgr., Treas., Loretto Iron Co., Loretto, Mich.

**John Elliott Arthur**, 3rd., South Charleston, W. Va.

Present position—1918 to date: Sub-foreman & Foreman, U. S. Naval Ordnance Plant.

Proposed by Wm. J. Priestley, J. S. Cunningham, G. S. Borden.

Born 1890, Cincinnati, O. 1906-09, Reading, Pa., Hgh. Sch. 1909-11, Pennsylvania State College. 1911-15, Chem., Reading Steel Casting Co. 1915-16, First Helper on Open Hearth, Carpenter Steel Co., Reading, Pa. 1916-17, Foreman, Melting Dept., Reading Steel Casting Co. 1917-18, First Helper & Melter, Carpenter Steel Co.

**Walter Robert Berger**, Winfield, Kans.

Present position—1919 to date: Geol., Emerald Oil Co.

Proposed by Alexander W. McCoy, Alfred J. Diescher, Everett Carpenter.

Born 1897, Johnson City, N. Y. 1910-13, Wynnewood Hgh. Sch. 1913-17, Oklahoma Univ. 1915-16, Draftsman & Geol., Empire Gas & Fuel Co., Winfield, Kans. 1917-19, Geol., Empire Gas & Fuel Co., Bartlesville, Okla. (3 mos. in U. S. Army).

**Wallace William Boone**, Cincinnati, O.

Present position—1919 to date: Asst. Head Chem. & Met. Peter's Cartridge Co., Kings Mills, O.

Proposed by L. Duane Simpkins, W. N. Thayer, Louis G. Robinson.

Born 1896, Cincinnati, O. 1910-14, Hughes High Sch. 1914-19, Univ. of Cincinnati, Ch. E. & Met. 1915-16, Asst. Chem., [Pittsburgh Testing Lab. 1916-17, Asst. Engr., Bureau of City Tests, Cincinnati, O. 1918-19, Met. Chem., Whitaker-Glessner Steel Co., Portsmouth, O.

**Lloyd Booth**, Youngstown, Ohio.

Present position: Treas., Trumbull Steel Co., Warren, Ohio.

Proposed by C. S. Robinson, E. T. McCleary, W. C. Reilly.

Born 1888, Youngstown, Ohio. 1912, Grad., Harvard Univ., A. B. Have been connected more in the financial & commercial ends of steel manufacture.

**Paul Hazlitt Davis**, Chicago, Ill.

Present position—1916 to date: Pres., Paul H. Davis & Co.

Proposed by Chester A. Hammill, A. Edmond Robitaille, Carlton Meredith.

Born 1889, Crawfordsville, Ind. 1907–11, Univ. of Chicago, Ph. B. 1911–13, Valuation wk., Security Dept., Colonial Trust & Savings Bk., Chicago, Ill. 1913–16, Valuation and statistical wk.; Partner, John Burnham & Co., Chicago, Ill.

**Henry B. Fernald**, New York, N. Y.

Present position: Member of firm, Loomis, Suffern & Fernald.

Proposed by P. A. Mosman, H. A. Guess, Judd Stewart.

Born 1878, McConnellsville, O. 1897–1901, New York Univ., A. B. 1910–17, Certified Public Accountant, Utah Copper Co.; Nevada Cons. Copper Co., Ray Cons. Copper and many others.

**William Julius Groetzinger**, Tampico, Tamps, Mexico.

Present position: Geol. Cia Mex. de Petroleo "El Aguila."

Proposed by Edward D. Lynton, Robert Linton, William R. Chedsey.

Born 1897, Pittsburgh, Pa. 1917–19, Pennsylvania State College. 1919, Geol. making reports and recommendations in the Mexican oil fields for Cia Mex. de Petroleo "El Aguila."

**Le Grand A. Harris**, Eureka, Nev.

Present position: Engr., Eureka Croesus Min. Co.

Proposed by F. L. Torres, Robert S. Lewis, Lapsley W. Hope.

Born 1892, Leeds, Utah. 1913–17, Univ. of Utah, B. S. 1917–18, Chem., Analysis of Ore. 1918, Research Fellow, U. S. Bureau of Mines. 1918–19, Engr. Corps, U. S. Army.

**Donald Charles Johns**, Danville, Ill.

Present position—1917 to date: Lt. Supply Corps, U. S. S. *Tonopah*, U. S. Navy.

Proposed by H. H. Stoek, J. Burns Read, J. R. Fleming.

Born 1892, Danville, Ill. 1912–17, Univ. of Ill., B. S. 1909–13, Chairman & Rodman, Engrg. Corps., Bunsen Coal Co. (now the United States Coal Co.), Westville, Ill. 1916–17, Efficiency wk., coke plant, Illinois Steel Co., Gary, Ind. 1917, Laborer, H. C. Frick Coke Co., Footedale mine, Pa.

**Guy Wesley Johnson**, Carthage, Mo.

Present position: Asst. Mgr., American Zinc, Lead & Smelt. Co.

Proposed by Howard S. Young, K. K. Hood, M. H. Newman.

Born 1890, Carthage, Mo. 1909, Carthage Public Schools. 1910, Bookkeeper, First National Bank, Monett, Mo. 1909–10, Asst. to Purchasing Agent. 1910–19, Warehouseman, Timekeeper, Costkeeper, Local Purchasing Agent & Supply Agent, American Zinc, Lead & Smelt. Co.

**Edgar L. Kerstetter**, New York, N. Y.

Present position: Treas., Mines Holding & Oper. Corp'n.

Proposed by H. L. Carr, J. Volney Lewis, N. C. Sheridan.

Born 1878, Elkhart, Ind. 1902–10, Sales Mgr., Chicago Tel. Supply Co., Elkhart, Ind. 1910–14, Sec. & Gen'l Mgr., Elkhart Mfg. Co., Monroe, Mich. 1914–15, Sales Agt., Peerless Check Protecting Co., Rochester, N. Y. 1915, Mgr., Pole Dept., Carbo Steel Post Co., Chicago, Ill. 1915–18, Mgr. Systems Dept., Jones & Baker, New York, N. Y. 1918–19, Asst. Treas., Finance Exploration & Dev. Corp'n. of America, New York, N. Y.

**Louis Livingston**, Chicago, Ill.

Present position: Transportation Wk. in Oil Fields, Texas (Ranger Field).

Proposed by Earl B. Noble, J. F. McClelland, A. P. Bradley.

Born 1891, Minot, N. D. 1912–17, Sheffield Scientific Sch., Yale Univ. 1917–18, Artillery Officer. 1918–19, Pilot in Aviation, U. S. Army.

**Stuyvesant Peabody**, Chicago, Ill.

Present position: Pres. Peabody Coal Co.

Proposed by Samuel A. Taylor, W. W. Kiefer, H. H. Stoek.

Born 1888, Chicago, Ill. 1905-07, Taft Sch., Watertown, Conn. 1907-11, Yale Univ. 1911-13, Operating Dept., Peabody Coal Co., Chicago, Ill. 1913, Salesman, Coal Supply Co. 1913-15, Dealer Sales Mgr. 1915-17, Vice-Pres. charge of sales. 1917, Pres., Peabody Coal Co. 1917-18, U. S. Army.

**Louis Reppert Putnam, Ashland, Ky.**

Present position—1911 to date: Treas. & Gen'l Mgr., Ashland Steel Co.

Proposed by H. D. Savage, C. J. Norwood, N. H. Mannakee.

Born 1864, Hope Furnace, Ohio. 1885, Marietta College. 1883-90, Various capacities, Ashland Iron & Min. Co. 1890-1911, Treas. Ashland Steel Co.

**Norman Read, Denver, Colo.**

Present position—1916 to date: Vice-Pres. & Gen'l Mgr., The Colorado Power Co.

Proposed by George A. Stahl, R. B. Paul, C. A. Schmitz.

Born 1883, Isle of Man, England. 1900-05, Univ. of Colorado, B. S. (E. E.) 1905-07, Engrg. Dept. Denver Gas & Elec. Co. 1907-09, Constr. & Installation, Hydro Elec. Designing. 1909-13, Elec. Engr. & Gen'l Supt., The Denver Tramway Co., Denver, Colo. 1913-16, Asst. Gen'l Mgr., The Colorado Power Co.

**Clarence Harold Smith, New York, N. Y.**

Present position: Chemist, New York Orient Mines Co.

Proposed by Clifford K. Clark, John E. Hodge, William Judson.

Born 1892, Long Pine, Neb. 1910-15, Univ. of California, B. S. 1915, Assayer and Surveyor, Western Nevada mines, Mason, Nev. 1915-16, Experimental wk.; 1916, Surveying & mill designing; 1916, Mill Night Foreman; 1917, Chief Chem., Nevada Douglas Cons. Copper Co., Ludwig, Nev.

**James Constans Stene, Eureka, Nev.**

Present position: Asst. Engr., Eureka-Croesus Min. Co.

Proposed by F. L. Torres, Lapsley W. Hope, F. W. McNair.

Born 1892, Kenyon, Minn. 1910-13, Univ. of Minnesota. 1913-16, Michigan College of Mines, B. S. & E. M. 1916-17, Engr., Merrit Dev. Co. and Cuyuna Minneapolis Iron Co., Cuyuna Range, Minn. 1915-16, Engr. Dept., Minneapolis General Electric Co. 1917-19, 2d Lieut., U. S. Army, A.E.F.

**Maurice Cortello Tobin, Butte, Mont.**

Present position: Engr., Elm Orlu Min. Co.

Proposed by Horace V. Winchell, Rush J. White, George E. Roddewig.

Born 1890, Cornwall, Ont., Canada. 1906-09, Montana State Sch. Mines. 1909, Chainman, Rodman, Level-Transit Computer, Chicago, Milwaukee & St. Paul R. R. 1910, Chainman Transit Experimental Dept. Converters, Nevada Cons. Min. Co. 1911, Transit, City of San Diego. 1912, Asst. Engr., Tonopah & Tidewater R. R.; Computer, E. H. Wilcox, Los Angeles, Calif. 1913-15, Draftsman, City of Los Angeles. 1916-17, Engr., Rocher De Boule M. Co., British Columbia. 1917, Engr., Ikeda Min. Co., Queen Charlotte Islands; Transit underground, sampler, Star Min. Co. 1918, Draftsman, Rush J. White, Wallace, Ida., Transit, Bunker Hill. Sullivan Min. Co., Kellogg, Ida.

### *Junior Associates*

**Edmund Arnold Anderson, Bridgeport, Conn.**

Present position—1917 to date: Student, Sheffield Scientific School, Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1899, Bridgeport, Conn. 1913-17, Bridgeport High Sch. 1918, summer, Witherbee, Sherman & Co., Mineville, N. Y.

**George H. Anderson, Champaign, Ill.**

Present position: Student, Univ. of Illinois.

Proposed by H. H. Stoek, J. Burns Read, J. R. Fleming.

Born 1898, Chicago, Ill. 1912-16, Deerfield Shields High Sch. 1916-19, Univ. of Ill.

**Lewis Edward Arnold, Minneapolis, Minn.**

Present position: Student, Minnesota School of Mines.

Proposed by W. R. Appleby, E. H. Comstocke, Peter Christianson.

Born 1897, St. Paul, Minn. 1904-11, Minneapolis Public Sch. 1911-15, Minne-

apolis Central High Sch. 1916, Univ. of Minn., Sch. of Mines. 1916-18, summers, Oliver Iron Min. Co. 1919, Surveyor & Assayer, Walker River Copper Co., Yerington, Nev.

**John Hamilton Ashley**, Berkeley, Calif.

Present position—1918 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1902, Clayton, Calif. 1915-18, Berkeley High Sch. 1919, Selby Lead Smelt. Co.

**David Birch Baird**, State College, Pa.

Present position—1917 to date: Student, Pennsylvania State College.

Proposed by Wm. R. Chedsey, E. S. Moore, W. R. Crane.

Born 1897, West Chester, Pa. 1913-17, Central High Sch., Philadelphia, Pa. 1917, summer, Riveter, Coxe Traveling Grate Co., Port Carbon, Pa. 1918, summer, Philadelphia & Reading Coal & Iron Co., Pottsville, Pa. 1919, summer, Designing, Baldwin Locomotive Wks., Philadelphia, Pa.

**George J. Barker**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1888, Sparta, Wis. 1911-17, Supt., National Zinc Separating Co., Cuba City, Wis.

**Charles Thomas Baroch**, Golden, Colo.

Present position: Student, Colorado Sch. of Mines.

Proposed by J. C. Roberts, I. A. Palmer, Lester S. Grant.

Born 1901, Chicago, Ill. 1915-19, North Side High Sch.

**Dallas Becker**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1888, Galesburg, Mich. 1917-18, Univ. of Wis. 1918, Analyst, control wks., Bucyrus Co., So. Milwaukee, Wis. 1918, Met. wk., Mineral Point Zinc Co., Depue, Ill. 1919, Analyst, Iron & steel wk., Continental Motor Co., Muskegon, Mich.

**Edwin Loren Bemis**, Houghton, Mich.

Present position: Student, Michigan College of Mines.

Proposed by F. W. Sperr, F. W. McNair, J. B. Cunningham.

Born 1893, Antigo, Wis. 1910, High Sch., Milwaukee, Wis. 1911-12, Univ. of Wis. 1915-19, Mich. College of Mines. 1913-17, Topographic Aid, field wk., U. S. Geol. Survey. 1917-19, 2d Lt., 29th Engrs., U. S. Army.

**Howard Edwin Bennett**, Berkeley, Calif.

Present position—1915 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1896, Springfield, Mo. 1910-14, San Diego H. Sch. 1917, Mucking & working on survey, North Star mines, Grass Valley, Calif. 1917, Asst. to Timberman, U. S. Smelt Co., Bingham Canyon, Utah.

**Jesse Lee Bennett**, Berkeley, Calif.

Present position—1914 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1893, Kernville, Calif. 1914, Polytechnic High Sch., San Luis Obispo, Calif.

**Herbert LeCain Berteaux**, Berkeley, Calif.

Present position—1918 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1899, San Francisco, Calif. 1914-18, Hollywood High School.

**Thornton C. Cash**, Golden, Colo.

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1900, Frankford, Mo. 1914-17, Bay City High Sch. 1917-19, Missouri State Univ.

**Willard John Classen**, Menlo Park, Calif.

Present position: Student, Stanford Univ.

Proposed by W. F. Dietrich, James M. Hyde, Baily Willis.

Born 1899, San Francisco, Calif. 1917, summer, With City Engr. of Redwood City, Calif.

**Donald Bennallack Collins**, Berkeley, Calif.

Present position—1914 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1896, Grass Valley, Calif. 1910–14, Berkeley H. Sch.

**Eugene Charles Curzon**, Golden, Colo.

Present position—1918 to date: Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1899, Livingstone, Mont. 1913–17, Polytechnic High School, Los Angeles, Calif.

**Francis Winne Dakin**, Golden, Colo.

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, James Underhill.

Born 1899, Evanston, Ill. 1916–17, Lawrenceville School. 1914–16, Evanston High Sch. 1918–19, Thacher School.

**Carle Hamilton Dane**, Bridgeport, Conn.

Present position: Student, Sheffield Scientific School, Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1900, Bridgeport, Conn. 1917, Bridgeport High School. 1918, Summer, Witherbee, Sherman & Co., Mineville, N. Y.

**Arthur Dorsey Davis**, Golden, Colo.

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, I. A. Palmer, Lester S. Grant.

Born 1894, Ashland, Wis. 1912–16, Lawrence College, A. B.

**Walter Lee Davis**, Columbus, O.

Present position: Student, Ohio State Univ.

Proposed by H. E. Nold, D. J. Demorest, Wm. J. McCaughey.

Born 1901, Ghent, Ohio. 1918, Grad., Alliance High Sch., Alliance, O.

**Earl James Donnelly**, Ontonagon, Mich.

Present position—1916 to date: Student, Michigan College of Mines.

Proposed by F. W. Sperr, J. B. Cunningham, F. W. McNair.

Born 1897, Ontonagon, Mich. 1915, Ontonagon Hgh. Sch. 1915–16, St. Thomas Col.

**Floyd Harriman Elliott**, Rapid City, So. Dak.

Present position: Student, So. Dak. State Sch. of Mines.

Proposed by W. C. Bochert, F. W. Traphagen, Charles Bentley.

Born 1898, Oregon, Ill. 1916, Oregon Hgh. Sch.

**Earle Chester Fairbrother**, Boston, Mass.

Present position—1916 to date: Student, Mass. Inst. of Tech.

Proposed by Carle R. Hayward, Edward E. Bugbee, Charles E. Locke.

Born 1898, Providence, R. I. 1915–16, Univ. of Toronto.

**William Fife**, San Francisco, Calif.

Present position: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1895, Reno, Nev. 1913–17, Univ. of Nevada. 1919, Miner, Engle Copper Co., Englemine, Calif.

**Clifford J. Forstner**, Madison, Wis.

Present position: Student, Univ. of Wis.

Proposed by E. R. Shorey, Richard S. McCaffery, A. N. Winchell.

Born 1902, Appleton, Wis. 1915–19, Appleton High Sch. 1918–19, Asst. Chem. Lab., Kimberly Clark Paper Co., Kimberly, Wis.

**Sydney Edison Fraser**, Berkeley, Calif.

Present position—1913–19: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1895, Parkville, Mo. 1909–13, Berkeley High School. 1913, Helper in

concentrate plant, Goldfield Cons. Mill. 1915, Empire Mines Co., Grass Valley, Calif. 1915-16, Sampler, Concentrate Helper, Battery Helper, Batteryman, Empire mill. 1916, Helper, Empire Cyanide. 1919, Surveyor, Empire mines.

**Ernest Herbert Frenzell**, Golden, Colo.

Present position—1917 to date: Colorado School of Mines.

Proposed by Lester S. Grant, J. C. Roberts, I. A. Palmer.

Born 1899, Redlands, Calif. 1913-17, Redlands High Sch. & Redlands Public School.

**Francis G. Grant**, Golden, Colo.

Present position: Student, Colorado Sch. of Mines.

Proposed by W. S. Larsh, J. C. Roberts, F. M. Van Tuyl.

Born 1899, Ogden, Utah. 1914-17, Salt Lake High Sch. 1917-18, Univ. of Utah. 1919, Colorado Sch. of Mines. 1918-19, Transitman, Nevada Cons. Copper Co.

**J. Baldomero Herrerias**, Berkeley, Calif.

Present position—1917 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1897, Spain. 1918, Haviland Fibbetts, Civil Engrs. 1918, Assaying, American Smelt. Refin. Co.

**James Ernest Hicks**, Golden, Colo.

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, I. A. Palmer.

Born 1899, Menominee, Mich. 1918, Pasadena High School.

**Robert Hilton**, New Haven, Conn.

Present position—1917 to date, Student, Sheffield Scientific Sch., Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1899, Chicago, Ill. 1913-17, Phillips Exeter Academy. 1918, summer, Rodman, Nevada Cons. Copper Mines Co., Ruth, Nev.

**Robert Hoffman**, Cambridge, Mass.

Present position: Student, Harvard Engrg. School.

Proposed by George S. Raymer, Albert Sauveur, H. L. Smyth.

Born 1898, East Boston, Mass. 1915-18, Harvard College, A. B.

**Javier Horcasitas**, Golden, Colo.

Present position—1918 to date: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, James Underhill.

Born 1898, Chihuahua, Mexico. 1911-16, New York Military Academy. 1916-17, Lehigh Univ. 1917-18, Columbia Univ.

**Howard Golden Hymer**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1896, Potosi, Wis. 1915-19, Univ. of Wis. 1919, summer, Economy Mines, Exam. Asst.

**Ralph McAllister Ingersoll**, New York, N. Y.

Present position: Student, Sheffield Scientific Sch., Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1900, New Haven, Conn. 1918, Hotchkiss Sch.

**Charles Harvey Johnson**, New Haven, Conn.

Present position—1917 to date: Sheffield Scientific Sch., Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1898, New Britain, Conn. 1915-17, Hotchkiss Sch. 1918-19, summer, Witherbee, Sherman & Co., Mineville, N. Y.

**Fred Duckworth Kay**, Golden, Colo.

Present position—1917 to date: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1900, New York, N. Y. 1913-17, Mercersburg Academy.

**Erwin Henry Kersten**, Minneapolis, Minn.

Present position: Student, Minn. Sch. of Mines.

Proposed by W. R. Appleby, E. H. Comstock, Peter Christianson.

**Born 1896, Minneapolis, Minn.** Minneapolis Grade Sch. 1911-13, Redlands, Calif., High Sch. 1913-14, Owatonna, Minn., High Sch. 1916-19, Univ. of Minn. 1917, summer, Compassman & Draftsman, Wis. State Geol. Survey. 1918, summer, Engr., Wacootah Mine, Iron Mountain, Minn. 1919, Asst. in experimental wk., Met. Dept., Homestake Min. Co., Lead, S. D.

**Clarence Edward Krebs, Berkeley, Calif.**

Present position—1918 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1898, Knowles, Calif. 1912-16, Stockton High Sch.

**Ray Joseph Larrabee, Richmond, Calif.**

Present position—1917 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1894, Dexter, Me. Worked for Standard Oil Co., also asst. in benzol production lab.

**Charles Hyde Lewis, San Francisco, Calif.**

Present position: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1894, San Francisco, Calif. 1910-14, Lowell H. Sch.

**Alfred Livingston, Jr., Berkeley, Calif.**

Present position—1918 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1896, Somerset, Ky. 1915-16, Univ. of Illinois. 1917, Superior State Normal School, Superior, Wis.

**Harry Edison Lloyd, Oakland, Calif.**

Present position: Student, Univ. of California.

Proposed by Frank H. Probert, Lester C. Uren, W. S. Morley.

Born 1896, White Oaks, N. Mex.

**Marcellus J. McKinlay, Madison, Wis.**

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1897, Dodgeville, Wis. 1910-14, High Sch., Dodgeville, Wis. 1914-18, Univ. of Wis.

**William E. MacArthur, Salt Lake City, Utah.**

Present position: Fellow in Met. Research, Univ. of Utah.

Proposed by Robert H. Bradford, Robert S. Lewis, Rudolf Gahl.

Born 1893, Rockford, Ill. Summer, Powder Man, Magma Copper Co., Superior, Ariz. 1912-16, Student, Univ. of Utah, B. S.

**George William Machamer, Golden, Colo.**

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, I. A. Palmer, Lester S. Grant.

Born 1901, Harrisburg, Pa. Baltimore Polytechnic Inst.

**Ralph C. Maxwell, Golden, Colo.**

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, I. A. Palmer.

Born 1902, New York, N. Y. 1910-16, N. Y. Public Schools. 1916-19, DeWitt Clinton High Sch. 1917, summer, Research Chem., U. S. Metals Co., Chrome, N. J. 1918, summer, Assayer, American Smelt. & Refin. Co., Perth Amboy, N. J.

**Dorsey Eads Mayhugh, Golden, Colo.**

Present position—1914 to date: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, James Underhill.

Born 1895, Rothville, Mo. 1912-14, Central High Sch., Pueblo, Colo.

**Harry C. McCartney, Golden, Colo.**

Present position: Student, Colorado School of Mines.

Proposed by Francis M. Van Tuyl, J. C. Roberts, Victor C. Alderson.

Born 1897, Evanston, Ill. 1912-15, Hinsdale High Sch., Hinsdale, Ill. 1915-16, Lyons Township High Sch., La Grange, Ill. 1919, summer, Chicago Tech. College, Chicago, Ill. 1917-18, Draftsman & Special Apprentice, American Steel Foundries, Chicago, Ill. 1918-19, U. S. Army.

**Austin Robert Montagu**, Houghton, Mich.

Present position: Student, Michigan College of Mines.

Proposed by W. S. Boyd, W. J. Hill, W. W. Currens.

Born 1885, Cromore, Ireland. 1892-1902, Stonyhurst Col., Lancashire, England.  
1902-04, Royal Univ. of Ireland. 1905-13, Michigan Col. of Mines.

**Fred Vail Moore**, Rolla, Mo.

Present position—1914 to date: Student, Missouri School of Mines.

Proposed by G. H. Cox, C. L. Dake, C. R. Forbes.

Born 1897, Festus, Mo. 1912-13, Cape Girardeau Normal Sch. 1915-18, summer, Smelter, St. Joseph Lead Co., Herculanum, Mo.

**Frank Ambrose Mose**, Berkeley, Calif.

Present position—1917 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1899, West Australia. 1912-15, Schools in England.

**Frank E. O'Neill**, Berkeley, Calif.

Present position: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Lester C. Uren.

Born 1893, Crozet, Va. 1908-10, Crozet High Sch. 1910-13, Richmond College  
1915-17, Colorado School of Mines.

**John Russell Perkins, Jr.**, Danbury, Conn.

Present position—1917 to date: Student, Mass. Inst. of Tech.

Proposed by Charles E. Locke, Carle R. Hayward, Edward E. Bugbee.

Born 1899, New Britain, Conn. 1917, Dartmouth College.

**Axel Johannes Peterson**, Golden, Colo.

Present position: Student, Colorado Sch. of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1898, Grayling, Mich. 1917, Grayling High Sch.

**Ralph Sterling Powell**, Golden, Colo.

Present position—1915-19: Baltimore Polytechnic Institute.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1901, Mathews Co., Va.

**Glenn D. Robertson**, Salt Lake City, Utah.

Present position: Fellow of Met. Research, Univ. of Utah.

Proposed by Robert H. Bradford, J. C. Williams, Rudolf Gahl.

Born 1896, Spanish Fork, Utah. 1915-17, Brigham Young Univ. 1917-19,  
Univ. of Utah, B. S.

**John Minor Rogers**, Berkeley, Calif.

Present position—1918 to date: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1900, Big Stone Gap, Va. 1911-14, Hemet Grammar Sch. 1914-17,  
Hemet High Sch.

**Joseph A. Roman**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1897, Ironwood, Mich. 1914, Grad., Viroqua High Sch. 1915, La Crosse  
State Normal. 1916, Rysion College. 1917-18, Univ. of Wis. 1918-19, U. S. Army.

**Dwight L. Sawyer**, Stanford University, Calif.

Present position—1913 to date: Student, Stanford Univ.

Proposed by W. F. Dietrich, James M. Hyde, Theodore J. Hoover.

Born 1894, Braceville, Ill. 1913, Miner & Surveyors Helper, Midas Min. Co.  
1914, Miner & Millman, Bunker Hill & Sullivan Min. Co. 1915, Mucker, Empire  
mine, Grass Valley & Sierra Battles mine, Sierra City, Calif. 1916-17, Topographer.  
charge of development work on copper property. 1917, Prospecting in N. W. Ariz,  
1917-19, U. S. Army.

**Harry John Schwartz**, Columbus, O.

Present position—1915 to date: Student, Ohio State Univ.

Proposed by H. E. Nold, D. J. Demorest, William J. McCaughey.

Born 1893, Columbus, O. 1908-13, North High Sch., Columbus, O. 1917,  
Heater Helper, Toledo Furnace Co. 1919, summer, Coal Sampler, Ohio State  
Univ. 1919, 2d Lieut., U. S. Army.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS lxiX .

**Theodore Joseph Serafini**, Golden, Colo.

Present position—1918 to date: Colorado Sch. of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1898, Philadelphia, Pa. 1917–18, Denver Univ.

**Don Valentine Slaker**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1893, Aurora, Ill. 1911, Grad., High Sch., West Aurora, Ill. Three months Asst. Engr., Davison Sulphur and Phosphate Co., Cuba.

**John C. Steward**, Golden, Colo.

Present position: Colorado Sch. of Mines.

Proposed by J. C. Roberts, Lester S. Grant, Victor C. Alderson.

Born 1899, Plano, Ill. 1913–15, Plano High Sch. 1915–17, Lawrenceville Preparatory.

**Robert Miller Stewart**, Oakland, Calif.

Present position: Student, Univ. of California.

Proposed by Frank H. Probert, W. S. Morley, Ernest A. Hersam.

Born 1897, Seattle, Wash. 1911–15, Fremont High School. 1919, Head Chain, Great Western Power Co., San Francisco, Calif.

**William Willis Storm, Jr.**, Norman, Okla.

Present position: Student, Univ. of Okla.

Proposed by Fred G. Rockwell, C. W. Shannon, J. B. Umpleby.

Born 1898, Oklahoma City, Okla. 1917, Geol. Mapping, Empire Gas & Fuel Co. 1918, Geol. oil exploration, Sinclair Panama Oil Co. 1919, By self, geol. reconnaissance, southwest Texas.

**Frederick Stewart Tumeaure**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1899, Madison, Wis. 1916, Univ. of Wisconsin.

**William Frank Uhlig**, Madison, Wis.

Present position: Student, Univ. of Wisconsin.

Proposed by Richard S. McCaffery, E. R. Shorey, A. N. Winchell.

Born 1899, New York, N. Y. 1918–19, Lehigh Univ.

**Newell R. Washburn**, New Haven, Conn.

Present position: Student, Sheffield Scientific School, Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1898, Susquehanna, Pa. 1917, Montrose High School. 1918, U. S. Navy.

**George Wright Weed**, Golden, Colo.

Present position: Student, Colorado School of Mines.

Proposed by J. C. Roberts, Lester S. Grant, James Underhill.

Born 1899, Boston, Mass. 1912–16, Brookline High School. 1916, Univ. of Maine. 1917–18, summers, Engrg. Clerk, Texas Steamship Co., Bath, Me. 1919, Tank Inspector, same company.

**John Conrad Wittenberg**, New Haven, Conn.

Present position—1917 to date: Sheffield Scientific School, Yale Univ.

Proposed by Robert K. Warner, Arthur Phillips, C. H. Mathewson.

Born 1897, Ironton, O.

*Change of Status—Junior Associate to Associate*

**Peter A. Aline**, Great Falls, Mont.

Present position: Research Dept., Anaconda Copper Min. Co., Anaconda, Mont.

Proposed by Enoch A. Barnard, H. Lee Welsh, W. C. Pryer.

Born 1892, Great Falls, Mont. 1907–11, Great Falls High Sch. 1911–15, Montana State Sch. of Mines, E. M. 1911–15, summers, Great Falls Reduction Wks., Anaconda Copper Min. Co., Great Falls, Mont. 1915, Sampler; 1915–16, Chem.; 1916–17, New Furnace Refinery, Great Falls Reduction Wks., Anaconda Copper Min. Co. 1917–19, U. S. Army. 1919, Chem., Great Falls Reduction Wks., Anaconda Copper Min. Co.

**GOLD MINING IN INDIA AS DESCRIBED BY HERODOTUS**

We have received from L. S. Cates, the following translation, by S. W. Mudd, of early mining methods in India:

In Herodotus one finds a description how Darius by aid of his good horse and his good groom Oebares got himself the Kingdom of the Persians. He then set up in Persia twenty satrapies assigning to each a governor and fixing the tribute which was to be paid to him by the several nations. The following description of the method of getting the gold demanded of the Indians as tribute is copied directly from Book III Thalia, paragraphs 94 to 105 omitting the diversions of Herodotus which in one case consisted of a lapse of two pages following a semicolon before the author returned to the subject.

The Indians, who are more numerous than any other nation with which we are acquainted paid a tribute exceeding that of every other people, to wit, three hundred and sixty talents of gold-dust.

The way in which the Indians get the plentiful supply of gold, which enables them to furnish year by year so vast an amount of gold-dust to the King, is the following: Eastward of India lies a tract which is entirely sand. Here, in this desert, there live amid the sand great ants, in size somewhat less than dogs, but bigger than foxes. The Persian king has a number of them, which have been caught by the hunters in the land whereof we are speaking. These ants make their dwellings under ground, and like the Greek ants, which they very much resemble in shape, throw up sand-heaps as they burrow. Now the sand which they throw up is full of gold. The Indians, when they go into the desert to collect this sand, take three camels and harness them together, a female in the middle and a male on either side, in a leading-rein. The rider sits on the female, and they are particular to choose for the purpose one that has just dropped her young; for their female camels can run as fast as horses, while they bear burdens very much better.

When the Indians therefore have thus equipped themselves, they set off in quest of the gold, calculating the time so that they may be engaged in seizing it during the most sultry part of the day, when the ants hide themselves to escape the heat.

When the Indians reach the place where the gold is, they fill their bags with the sand, and ride away at their best speed; the ants, however, scenting them, as the Persians say, rush forth in pursuit. Now these animals are, they declare, so swift, that there is nothing in the world like them; if it were not, therefore, that the Indians get a start while the ants are mustering, not a single gold-gatherer could escape. During the flight the male camels, which are not so fleet as the females, grow tired, and begin to drag, first one, and then the other; but the females recollect the young which they have left behind, and never give way or flag. Such according to the Persians, is the manner in which the Indians get the greater part of their gold; some is dug out of the earth, but of this the supply is more scanty.

## STANDING COMMITTEES

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## EXECUTIVE COMMITTEES OF LOCAL SECTIONS

*New York*—E. P. MATHEWSON, chairman; F. D. ALLER, secretary, 120 Broadway, New York, N. Y.

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## Federal Taxation of Mines

Discussion of the paper of L. C. GRATON, presented at the Chicago meeting, September, 1919, and printed in *Mining and Metallurgy*, No. 155, November, 1919, p. 2957.

W. O. HOTCHKISS,\* Madison, Wis.—It was fortunate, in a way, that this subject of income taxation came up during the war when the government could appeal, on the basis of patriotism, to men of large business experience to undertake the work of formulating this matter and practically donate their services. At any other time the government would have been unable to secure the necessary number of men of like ability.

There is one thing that must not be forgotten. In all cases, except the very largest and most important, the application of this income tax law to a mine is going to be made by clerks whose salaries are fixed by a Congress that appropriated a half billion of dollars for a war purpose and provided that \$4000 should be the highest salary paid in the administration of that great sum. The Congress of the United States unfortunately seems almost entirely unaware of the fact that men of ability and experience are worth money and must be paid adequately if proper public service is to be secured. While the formulation of the broad plans for administering the law have been in the hands of men of unusual ability, we have the future to guard, and, if possible, the mining industry should see to it that the Internal Revenue Department is permitted by Congress to pay salaries that will enable it to secure men of the ability and experience necessary to insure proper consideration of the industry.

Another fact to which I would call attention is the difference between the business and the economic, or economists', points of view as to what a mine is. The economists have properly, from their point of view, classed a mine as a wasting asset, but the average metal mine is not a wasting asset if it is a real mine. The economists are correct in a broad sense in that every ton of ore taken out diminishes the orebody by that amount. When it comes to the consideration of an individual mine from the business standpoint, the future of that mine rests on unforeseeable events—the discovery of new orebodies or the development of old bodies beyond the point of probable expectations. Every going mine must develop new ore each year to replace that extracted, and, during all but the last one or two years of its activity, actually does so. Instead of being a “wasting asset” such a mine, from the practical standpoint which must control valuation, is an “increasing asset.” From

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\* State Geologist of Wisconsin.

the businessman's point of view, when an ordinary moderate-sized mine reaches the stage when he knows the full amount of tonnage available and can figure the life of that property within reasonable limits, it is on its last legs and is not a going proposition any longer. This statement is true of the vast majority of mines other than coal mines. There are a few exceptions in the largest metal mines, but they number only a few score out of the 35,000 mines of the country. We can make district totals and range averages and all that sort of thing with fair accuracy, but when we come to apply this method to a particular mine it is absolutely beyond human ability to say that a particular mine is going to produce a certain definite percentage of what you can reasonably prophesy for a whole district. Any method of valuation, therefore, which is based on the estimation of future production and future profits is going to fit properly only coal mines and a very few of the largest metal mines. When the smaller metal mines—the vast majority—are considered, they can rest assured that the one great factor in their valuation is going to be, not ore reserves, not profits, not the risks incident to the working of a particular property, but the judgment and experience of the particular employee of the Bureau of Internal Revenue in charge of the work for that particular mine. For this reason I have put first in importance the personnel of that Bureau.

I want to call your attention further to an important matter that I believe will come up for consideration. Suppose a man buys a lot on the street corner for \$1000, on which, by the expenditure of a moderate amount of energy and money, he builds a house. Because of a real estate boom, at the end of the year he is able to sell it for \$100,000; his income tax is based on that selling price minus what he actually invested in that property. On the other hand, should he expend on the property a moderate amount of energy, time and money and find an orebody worth \$100,000, and then sell the property for \$100,000, this law permits him, when he has discovered that orebody, within 30 days to revalue that property and to have back as return on capital its full present value. There is a dangerous parallelism in those two cases; I do not know—I have not gone to the bottom of it—whether this deduction for capital, based on revaluation every time a discovery is made, is going to be able to withstand the light of good business judgment.

Another matter to which I want to call your attention is the effect of interest rate on valuation. This law, carried to its logical conclusion, and assuming that you can accurately measure and revalue a deposit within 30 days after you have found it, means that the discount rate you assume is the rate of profit that this company is going to make, and the rate on which its income taxes are going to be based.

Mr. Norris does not believe the coal industry should be burdened with a high rate. In the iron country they are demanding a high rate of

discount, which means a low present value of capital for real property assessment. Then the profits are based on a low capital which means a larger percentage of profit and that commands a larger rate for income taxation. On the other hand, if the discount is made at a low rate it means a larger present value and a lower percentage of profit (although the total amount of actual profit is the same in both cases) and consequently a lower rate of income tax. Now the difficulty comes from the fact that we cannot estimate the value of any orebody 30 days after discovery, and consequently there is going to be much difficulty in the application of this law.

THE CHAIRMAN (R. C. ALLEN,\* Lansing, Mich.).—It might help a little in determining the tonnage in a mine, as of 30 days after date of discovery, if one would first determine date of discovery. How are you going to fix the date? Perhaps someone will answer that before we get through. We are also interested in valuation as related to invested capital. This subject is open to discussion.

WILLIAM P. BELDEN,† Cleveland, Ohio.—The legal profession, for the gold mines, the copper mines, and some of the iron mines, sought to establish in the courts the proposition that the entire return for the sale of ore, or metals, constituted the return of capital; but the courts rejected that theory and have adopted the one the engineers developed—that ores or metals in the ground have a certain unit value, analogous, if you please, to the stumpage value of the timber in the forest, and that the amount received from the sale of that ore, or from these metals when marketed, is a combination of the tonnage value of the ground plus the cost of operation, with a fair profit to producer. The mining industry owes a debt of gratitude to the engineers who have advised the Federal Administration on this question. The law of 1909 allowed no deductions and the law of 1918 has this whole scheme worked out.

The point that I wish to make in connection with Mr. Graton's address is rather by way of comment than of criticism. The tax law may be divided into three divisions: the income tax, the excess profits tax, and the capital stock tax. The question of valuation enters into all three and the principal debatable questions in federal taxation relate to the deductions we may make from income.

With reference to the income tax law, the question is: What deduction shall we make for depletion? Nothing can be said in addition to what Mr. Graton has said on that subject. On the capital stock tax law, the basis of valuation is the fair value of the stock, but Mr. Graton is in error in his comment on the excess profits tax. He says, "Valuation underlies

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\* State Geologist of Michigan.

† General Counsel, Cleveland Cliffs Iron Co.

the determination of invested capital for the excess profits and war profits tax." I wish it did.

The regulations issued by the Department say, "In the case of the war profits and excess profits tax, invested capital is based upon the actual investments of the stockholders of the corporation, irrespective of the present value of its assets."

This regulation operates unjustly and practically penalizes conservative companies. For example, in northern Michigan, many years ago a property was purchased for \$3000, on which iron ore was discovered prior to Mar. 1, 1913. That property is now assessed by the state of Michigan, for purposes of taxation, at \$600,000. For purposes of depletion, that sum is used as the basis; but for the purpose of determining the invested capital of the owner on which to compute his 10 per cent. exemption he may only include the \$3000. How does this work out?

Two companies, A and B, were organized some years ago, each with \$5,000,000 worth of stock. In the course of time they developed additional ore deposits, and by 1913 their properties were each worth \$10,000,000. Company A issued stock against its additional developed value so that it now has a capital of \$10,000,000. Company B did not do that and retains its original stock at \$5,000,000. In figuring the exemption on invested capital, Company A takes out 10 per cent. on \$10,000,000; while Company B is limited to 10 per cent. on \$5,000,000, because the regulations provide that appreciation in value will not be included in invested capital.

Invested capital as defined in this Act includes cash paid for capital stock, also stock paid for with tangible property, and to a limited extent with intangible property. It also includes paid-in and earned surplus.

It is our contention that developed value which has accrued prior to the effective date of the tax law, through the discovery and development of additional orebodies, has become an addition to capital analogous to surplus and should be included within the meaning of that term, in determining the amount of invested capital. Unless this is done the law creates an inaccuracy between taxpayers engaged in the same business which, as Mr. Graton has said, is bound to create unrest and dissatisfaction.

PAUL ARMITAGE, New York, N. Y.—Mr. Graton has covered the subject of the valuation of the mines very completely, but he has not touched the rate of depletion. At what rate shall we deplete? We find literature pertaining to economics and engineering replete with discussions as to the rate of depreciation. We find all sorts of suggestions as to the rate at which we shall take depreciation and as to how it shall be measured. We find the straight-line method, the reducing balance of cost method, the annuity method, and the unit cost method. But

when we come to depletion we find that only one method has been proposed and adopted by the government, and that is what Mr. Graton has aptly termed "the coincident method." It is the method suggested by the Treasury Regulations with which you are familiar. I may call it the "stock-in-trade" method or take-as-you-go method; i.e., an allowance based on the quantity mined each year. That method is not the only one or the only correct method that should be applied to mines. It is not the only one that is adapted to all the complexities of the various kinds of mining industries with which the Treasury Department will be confronted in its attempt to give us a fair deduction for depletion. Before we approach the question of rate, two things must be settled: First, the value of the property and, second, its term of life.

The question of the rate at which we shall take depletion does not emerge until the two factors have been settled. My discussion is not concerned with either the value of the mine or its life. We have given, therefore, a mining property of value known or agreed upon and its life. We know that at the end of its life, that value will be zero. We further know that under the Treasury Regulations we are permitted to amortize that value. How shall it be done?

The regulations say that the purpose of depletion is to amortize capital. I will briefly quote the section:

Art. 201 . . . The essence of this provision is that the owner of such property, whether it be a leasehold or freehold, shall secure through an aggregate of annual depletion and depreciation deductions a return of the amount of capital invested by him in the property, or in lieu thereof an amount equal to the fair market value as of March 1, 1913, of the properties owned prior to that date. . . .

It is not necessary to amortize this capital value by depletion rates that coincide with the rate at which the property has changed in value. Now, is it essential that the only way to do that is by this "take out as you mine" method of the government? I say, "No!" The government should adopt the same attitude toward the rate of depletion that is adopted toward the rate of depreciation that we are allowed.

The government is very fair on that; it says on depreciation we may take any standard method, so long as we are consistent.

The capital sum to be replaced should be charged off over the useful life of the property either in equal annual installments or in accordance with any other recognized trade practice, such as an apportionment of the capital sum over units of production.

Why should not we be allowed to deplete, "according to the peculiar conditions in each case?" It may be answered that the law compels this to be adopted. I answer, the law does not compel anything of the sort. A broader, fairer, or more liberal law cannot be imagined. The text of the present law of 1918 is "a reasonable allowance for depletion according to the peculiar conditions in each case." The Treasury Department

says, "Only one method shall be allowed to deplete." I ask, gentlemen, what opportunity is there for applying that law if we are going to be fettered hand and foot by this single definite method?

If we are going to apply this law reasonably, "according to the peculiar conditions in each case," we must allow different rates of depletion. For example, in the short-lived zinc mines of the Joplin district, we should allow what I may term a "concave curve," a curve at which the greatest depletion is taken out the first year, and a lesser depletion in the later years. In a porphyry mine where the content is known, where it is more or less of uniform grade or quality, probably the "take as you mine" method of the Treasury Department is fair. But attempt to apply this rule to a deep-veined limestone mine, where we have only 2 or 3 years in sight and a large value of prospective ore and highly different grades of ore, ranging from 43 per cent. down to 7 per cent. copper.

Let us see where the Treasury will leave us. We will first assume—and it is a fair assumption—that the rich ore will be mined first as it is reached first; it is the more profitable, therefore we will get the larger profit on it; the poorer ore we will reach later. Assume that the copper in this mine is 1,000,000,000 lb. of which the high-grade ore averages two-thirds, or 666,000,000 lb., and the low-grade ore amounts to, approximately, 333,000,000 lb. The profit on the high-grade ore is 10 per cent., or \$66,000,000 in round figures, and the profits on the low-grade ore is 5 per cent., or \$16,000,000. Adding these figures gives a total value of \$82,000,000. Assume a life of 10 years, this gives an expected annual income of \$8,200,000. The present value of that income would be in round figures \$66,500,000 +; amortized over 15 years it would be \$59,000,000 +. Applying the Treasury rule to those figures for depletion, you must divide the \$66,500,000 by the total number of pounds of copper, or 1,000,000,000, and be allowed a depletion of 6.65 c. per pound; or on a 15-year rate of 5.9, or 6 c. per pound. In the first years, when we get a 10 c. profit, all is well, we readily obtain the depletion of 6.65 c. + but in the latter years of that mine's life, when we only have a 5 c. profit on that ore, how can we take 7 c. out? We must have a different method of provision, or we will lose during the wealthy years and during the later years there will be no income.

That, gentlemen, is an illustration of what this rule means: Any fair-minded man will say, and very properly, that we should take out more in the earlier years and less in the later years—that would be a reasonable depletion according to the peculiar circumstances of the case. The Treasury rule prohibits it. Therefore, I say the Treasury should amend its rates and give us the same ruling it has in the case of depreciation, and the reasonable depreciation should be allowed, and we should take it in equal installments or in accordance with any other recognized trade practice.

L. C. GRATON.—I should like to add at this time that my paper was written, or the ideas, at least, were gotten together from the standpoint of copper-mine taxation, which is the thing that I am specifically held responsible for. It turned out it would not be feasible to have the whole field covered by specialists just at this time, so I presumed to spread the principles of the copper mine over the whole field simply in order to spread the target. I should apologize, therefore, to many of you who are interested in other things than copper for confining my illustrations and, no doubt, for the narrow scope of many of the principles of my application to copper in particular. I am simply one of several engineers down there who jointly will have to take the case for the job.

You will be interested to know, I am sure, that except for a man to take care of coal, our major organization has now been perfected. Gold and silver are to be under the supervision of Mr. J. C. Dick, a mining engineer and operator of long and varied experience. Iron will be handled by Mr. E. C. Harder of the U. S. Geological Survey. Lead and zinc are to be in the hands of Mr. C. E. Siebenthal, another representative of the Geological Survey. All this work is centered in the Sub-division of Natural Resources, a reorganization of the national resources work after the departure of Dr. Ralph Arnold, who had been acting head of the entire group and had specific charge of the oil and gas program, already well advanced. The senior engineer in oil, who was likewise the senior engineer in the whole group of natural resources, Mr. J. L. Darnell, has been put in charge of the new Sub-division. We hope to secure a high-grade coal man, and then we shall feel pretty well prepared to accept and put into practice, so far as good common sense and the law jointly will permit, all the suggestions that have already been given and that today's discussion will no doubt increase.

CHAIRMAN ALLEN.—This idea of a specialized administration in the Bureau of Internal Revenue is new. It was attained with a great deal of struggle and trial on the part of the Commissioner and his assistants. This unit is known, I believe, as the Natural Resources Division and is the first of these special units to be developed. Grouped together in this unit are timber, oil, gas, and mines. The problems of taxation of incomes from wasting resources in essence are the same whether dealing with exhaustible timber, exhaustible oil, or exhaustible minerals. The principles are the same. In detail the problems are a little different. Therefore, they have divided the unit into three sub-units, viz., mines and minerals, oil and gas, and timber. At the head of each of these sub-units there is an expert, who is surrounded by his assistants who are peculiarly qualified for the work they have to do. The taxpayer now has a great deal to hope for from the increased efficiency of the administration of the taxes on wasting resources industries which will develop under this specially organized division of the Bureau of Internal Revenue.

The discussion shows some of the trains of thought that may be set in motion by a consideration of this subject. But, in order to block out the limits of profitable discussion, perhaps it might be well for us to consider the subject in this wise: The revenue law of 1918, as applied to mines, leaves certain matters to be determined within certain limits in the discretionary authority of the Commissioner of Internal Revenue; certain other matters are defined and fixed by the law itself. It will not be profitable to discuss amendments to the law. But those parts of the law which are expressed in general terms, leaving considerable latitude for the exercise of discretionary authority by the Commissioner of Internal Revenue, should be thoroughly discussed.

Mr. Graton gave a very excellent outline of some matters that are within the discretionary authority of the Commissioner. The determination of the value of a mining property, for instance, is an act of human judgment. Therefore, the methods of determining the value of mining property, I should say, will profitably and advisably come within the range of this discussion. A second question is the determination of the rate at which the value or the cost of a mine may be written down and charged off as return of capital tax free; in other words, the rates of depreciation and depletion. A third question is the determination of invested capital in those cases where the books of account do not clearly reflect it.

In exercising discretionary authority, the Commissioner must act through his agents appointed for that purpose and some of them have come to discuss with us ways, means, and methods of approaching and solving some of these complex problems. I think, therefore, that we should confine our attention to those phases of the subject wherein we may contribute something of assistance, importance or value. Another of these difficult subjects is the application of the provision of the law that permits the discoverer of a mine to set up in his accounts the value of his discoveries for depletion purposes. Doubtless all of us have been struggling with the problems of determining what constitutes discovery, the date of discovery, and the value of a discovery. There are present today representatives of all of the great mining groups, and I would like to ask Mr. Graton to explain what is the present opinion within the Bureau of Internal Revenue of what constitutes discovery and what methods have been considered by which the date of discovery may be determined.

L. C. GRATON.—I would be glad, gentlemen, to give you something definite and specific, but you have touched upon a particular topic on which no final decision has been reached, and which, because of differences of view at present regarding it, I do not feel quite free to discuss. Unfortunately, the Chief of our Sub-division, Mr. Darnell, left the room a moment ago. I would have been glad to refer the question to him because

in the oil section, particularly, he has had much to do with the subject of discovery; and inasmuch as the oil program is much further advanced than that for mining, they have presumably settled most of the principles upon which valuations of oil property must rest, indeed they have proceeded far into the actual settlement of individual cases. But to some extent, the matter of discovery, even as applied to oil, I believe is still open.

We have been told that the clause relating to discovery was inserted in the law primarily to take care of the oil wells and, above all, to take care of the oil "wild-catter." That is information which must of necessity come extraneously, for in my opinion neither idea is expressed in the wording of the law itself. I suppose the law itself must be our guide.

I trust you will not conclude that Mr. Dick, Mr. Siebenthal or I will hesitate to answer your question if we can. But our primary object in coming here at this stage in our campaign was to learn what your ideas are. We should like to hear from Mr. Smith and Mr. Jones and Mr. Brown about discovery, about invested capital, about depletion rates, and all the other problems.

E. F. BROWN,\* Iron Mountain, Mich.—The subject is a very interesting one from the standpoint of the man who has to make out the income-tax statement. As a concrete example, the properties in which I am most particularly interested were developed to a considerable extent prior to Mar. 1, 1913. The question arises with us as to the date when the value of that property is to be established as a part of our invested capital and surplus. The corporation, being organized in a very conservative manner, is in a peculiar position perhaps, although I have no doubt that there are many mining corporations in the same position.

The question of exhaustion of resources, which Mr. Graton has discussed very thoroughly in his paper, is another of the problems—the question of how much depletion is allowable in a given year and upon what basis that depletion can be calculated. There is nothing in the Internal Revenue regulations, nor in Mr. Graton's paper, that gives definite instruction or a definite method to follow in computing either depletion or a percentage allowable from annual earnings for the perpetuation of a corporation's industrial life. The method of ore valuation that Mr. Finlay instituted, and which has been followed in Michigan by Mr. Allen, appears to offer some solution of the depletion proposition, some possibility of solution. That method, however, is rather imperfect if we consider that the value of a property which is now and has been in the same hands long prior to Mar. 1, 1913, had its value as of Mar. 1, 1913, regardless of the exact amount of minerals at that time developed or that could be estimated.

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\* General Manager, Pewabic Co.

I think these problems should be thoroughly considered by persons conversant with the metal-mining industry because we have entered upon what appears to be a long period of taxation on this basis and if we start with equity and justice to the government and the taxpayer in view, it must come through an unprejudiced consideration of both of these important points.

CHAIRMAN ALLEN.—I think that most of the mining companies doing business in the Lake Superior country are somewhat in the position of the company that Mr. Brown represents. They were formed prior to Mar. 1, 1913, and the properties now in operation were in operation on that date. In many of these cases the value of the property as of a date prior to Mar. 1, 1913, will affect "invested capital." However, many mines and corporations now operating in the Lake Superior country have had their birth since then. Perhaps we may cite a case to get at the heart of the matter.

In the usual case the history of the development of a Lake Superior iron mine is this: Some concern or explorer selects a piece of ground where he thinks there is a possibility of the occurrence of ore. He gets an option for a lease and explores the property. If he is successful in locating ore he eventually sinks a shaft and installs a mining equipment. In other words, he discovers and develops a mine. It seems to me that the law specifically extends to that operator the privilege of depleting the full value of his discovery. It says in effect, if the value of the discovery is materially in excess of the cost thereof, the excess value over cost may be added to the cost and the whole sum may be set up in the accounts for purposes of depletion. The cost of the discovery is always returnable through depletion and depreciation. It is the excess of value over the cost that we are talking about. Ordinarily the drilling proceeds continuously until the operator is satisfied that he either has or has not a mine. If ore is discovered and developed by the addition of one drill hole after another, there is a continuous process of discovery but somewhere in the course of the operation some approximate date of discovery of the deposit will probably be suggested. In any case, the date of discovery should perhaps not be advanced beyond the time when the operator elects to take a lease on the property.

Personally, I have had to do with this problem in recent months in the Miami zinc district of Kansas and Oklahoma. This district was developed during the war period; it was not known in 1913. This discovery clause is of transcendent importance to the operators of this district and many of them are making claims for depletion on account of the discoveries they have made. It becomes necessary under the law to fix the date and the value of each discovery with respect to the peculiar conditions in each case.

Here is one test that was applied in determining dates of discoveries in the Miami district. In that district it is necessary to mill the ore; if an orebody is found, a mill is erected. We have in no case advanced the date of discovery beyond that of the beginning of the erection of the mill to treat the ore, taking it for granted that an operator would not erect a mill unless he thought he had discovered a mine. Extension of known orebodies by drilling after the date of beginning construction of the mill were not believed to constitute discovery but ores discovered prior to the erection of the mill were included in the discovery value. That is merely one test that has been used. It would not apply to the iron mines of the Lake Superior country. You would have to use other tests there. In fact, each district has its peculiar types of orebodies and mining operations, so that a test of discovery in one may not apply to another.

WILLIAM KELLY, Vulcan, Mich.—The date of discovery in most mining operations cannot be definitely fixed. In such mines as the zinc mines that lie near the surface, as has been suggested, the date perhaps can be determined; but where an orebody is found by drilling, even after drilling has continued a long time, there may be doubt as to whether there is a commercial body of ore and it is necessary to sink a shaft or extend drifts to open up the body. It may take a long time before a commercial orebody is definitely determined. Why is it necessary to limit the time of determining the value of a discovery to 30 days? After a period of 30 days, in certain cases, there may be a determination of value but in the majority of these cases it will only be partly determined so that some time later the value of the discovery will have to be redetermined. I cannot see how there can be a limitation of time of discovery in the great majority of cases.

L. C. GRATON.—May I say a word upon that subject? I shall not try to tell you what is the date of discovery, but there is a point in connection with this matter which it seems to me that all interested in mining might well consider. I understand that the discovery idea, and the features entailed with it in the law, like the 30-day period, are the results of a strong effort, made at the time the law was framed, by representatives of the oil industry to see to it that their industry was afforded such necessary provisions as would give it a square deal. Metal and coal mining, as I understand it, were not so strongly and persistently represented. One apparent consequence is that the law, as it stands, is going to be rather easier of application to oil and gas wells than to mines. Here, it seems to me, is a lesson for those interested in mining.

CHAIRMAN ALLEN.—Mr. Graton, would it be fair to ask if it is your opinion that that clause applies to the discovery of mines with exactly the same meaning and with the same force and same effect that it applies to oil?

L. C. GRATON.—I am really sincere when I say that that is one of the topics on our program for the future and has not been at all settled this far. My own inference from the law is that it intends to accord to the owners of mineral deposits concealed in the ground certain benefits consequent upon the disclosure and proving of those deposits, and that it intends that mines on the one hand and oil and gas wells on the other should share in these benefits in an absolutely equivalent and equitable fashion. But this does not mean that the means for attaining this object must be identical in both instances; it cannot have such meaning without ignoring the actual differences between oil or gas wells and mines and without violating common sense. If the government were to send out a general order to its consuls in foreign capitals directing them to report at once in Washington and specifying that it would repay traveling expenses, the refund for expenses certainly could not sensibly or fairly be allowed to the representative in Ottawa because he traveled a short distance by train, yet denied to the London consul because he had to come a long distance and by steamship. Equivalent, not identical, treatment is required for such cases.

As already intimated, the language of the law is more the parlance of the oil man than of the miner. But it is our duty, as I see it, to make the evident intent apply equitably to each. The actual discovery of an oil well, of course, is a thing of perhaps only an instant. The drill reaches the proper point—and out rushes the oil, commonly in great volume. Experience has shown that from the initial flow of an oil well, or from the flow as it settles down after a few days or weeks, the value of the well may be deduced with a good degree of accuracy. So for that, the 30-day period is satisfactory. Ore and coal, however, do not trip eagerly out to meet the miner the moment he taps the margin of their deposit. To ascertain how much is present and what it is worth, he has to go into the deposit and he has to spend time and good money to get there.

Personally, I see no way of making the discovery clause effective except by saying that to "discover" is to "determine." That, it seems to me, is what the law really means, what it must mean. If you determine that you have a mine, then you have discovered a mine; but unless you have reasonably completed that determination you do not know whether or not you have a mine or what its value is. Then, as I take it, after you have made the determination, you have 30 days of grace to think it all over, put in an extra round of shots in a place or two that look particularly good, figure up the tonnage, grade, and value, and then make your showing.

I realize that this is heretical doctrine from the standpoint of the older regulations, but I believe that it is what the 1918 law intends. I realize also, however, that there are things which we, as engineers, might like to read into the law but which, in fact, we cannot do. Even so,

the case may not be hopeless, because while the present law is presumably to flow on indefinitely in its terms and its rates of levy, we may feel confident that if injustices or inconsistencies are revealed in it, they will be remedied. At the worst, the industry will have to bear them only for the time required to disclose and demonstrate them.

Probably this matter of education on both sides is going to be a rather slow job. I say education on both sides, for I believe that mining men themselves need to take a new and better grip on their understanding of their business. They have got to go to the bottom of what they are doing, analyze the entire situation thoroughly, and acquire a complete and masterful understanding of the fundamentals. For instance, it is my belief that we are selling a lot of our mineral products at prices that do not return true cost. If that is so, then there is only one answer—the prices must go up. We cannot find real remedy in legislation, in depletion allowances, or in any other artificial means if we are selling our products at prices that include only certain costs without taking into account the fundamental cost of the stuff itself.

Take, as an illustration, the example to which Mr. Armitage referred. If the mine he mentioned is going to face the latter half of its life without enough profit in the ore to cover the cost (or value) of the ore to the company, then only one of two things can happen. Either the company will quit business—but that cannot be for the copper from that mine and others like it is needed by the world's industries—or the selling price of the product must be raised to the point necessary to cover all costs plus reasonable minimum profit. If the mine cited were unique as to its position in this regard, it might indeed have to close down, but I believe it is not unique, but rather representative.

I am certain that millions of pounds of copper, and of other metals as well, have been sold in the past without the slightest regard for their inherent cost or value and without a single provision for replacing them—in other words without providing for continuing enterprise. This is unquestionably unsound economics. Our American producers of mineral products are entitled to no credit for underselling the rest of the world if they have been able to do so only by using up the best of the deposits which nature so bountifully placed within our borders and which, while the country was young and knowledge of these things imperfect, could be secured for a song. Such a policy is unsound and must be as short-lived as that of the profligate who squanders both income and capital in riotous living.

If the present heavy taxes, by forcing mining companies to examine and analyze minutely their true situation, have the effect of driving home these lessons and of instituting a sounder basis for the conduct of the mining business, I believe the game will have been worth the candle. Indeed, for my own part the appeal and inspiration of watching in at

the game while such an outcome as I have implied is taking shape is one of the bright prospects in what will be a trying, and perhaps thankless, job of helping to administer the tax laws to the mines.

Let me not be understood as implying that the situation to which Mr. Armitage referred has the only application or consequence I have implied above. As a matter of fact, I for one have gained from his example a clearer understanding of what depletion really is and how it ought, in fairness, to be computed, than I have had hitherto. He has shown us, I think, that one pound of copper in a mine is not necessarily the same as every other pound—that the extraction of certain pounds of metal, because being contained in rich ore they represent greater profit, inflict a greater impairment of the value of the mine than the exhaustion of an equal number of other pounds which cost more to produce because contained in lower grade ore; and of course, no impairment of mine value would result from the removal of countless pounds of copper if contained in stuff of far too low grade to yield any profit.

**WILLIAM KELLY.**—Is it not within the province of the department to revise year by year this determination of value of discovery?

**L. C. GRATON.**—I do not know. It may be that the Chairman, from his experience both in Washington and in mine taxation in general, can answer that. I wish he would answer Mr. Kelly. I do not see how we are going to have a logical program worked out unless some revision is possible. But I do know that whatever we may wish is not going to change the laws as they now stand; here and there we are going to bump square into the concrete walls of the law. Whether or not this point raised by Mr. Kelly is such a case, I am not now prepared to say.

**CHAIRMAN ALLEN.**—I think this subject should be discussed further. I fear I do not yet quite understand Mr. Graton. The question that all of us have in mind is simply this: Do discoverers of mines benefit by the clause in the law which apparently in its wording permits them in case of discovery of a mine subsequent to Mar. 1, 1913, of a value materially in excess of the cost, to set up in the accounts, the value of that discovery to be returned tax free out of the income of the operation of the discovered mine? That is, as I take it, the heart of this discussion. I do not believe Mr. Graton has made himself clear. Perhaps he is not himself quite clear on the meaning of the law. Does the mine operator benefit by this clause in the law and if he does to what extent does he benefit? This is a matter of enormous importance to a great many miners in this country now and if the clause stands in the law, it is going to be of great importance in the future.

**A. D. BROKAW,** New York, N. Y.—While I was in Washington, I had considerable difficulty with this matter of date of discovery and,

unfortunately for you and for me, it fell upon me to very hastily throw together that document known to you as Form A revised, Questionnaire on Mines. By scurrying about in the Bureau of Mines and among my mining acquaintances in New York, I decided that the best I could do was to say the date of discovery of the mine is the date upon which it could have been shown by an experienced competent engineer that there was sufficient material in sight to justify operation on a commercial scale.

I may say that I have had the temerity to set up a claim for revaluation on the basis of discovery in the case of a coal mine in the New River district. This falls not under the clause of new discovery, but under the clause of the regulations that allows valuation in the case of a mine that has been abandoned or sold as essentially worked out. I do not remember the exact wording. This particular working had never been profitable. An entry had been driven some thousand feet back in coal in different quality, when what is called a "swag," a channel in the coal, was struck. This was a sharp dip of perhaps  $12^{\circ}$ , the coal rapidly thickening up to 6 ft., and then rising on the other side and pinching down to 6 in. This coal had been mined out and it was necessary to drive entries and carry on exploration work in order to find out whether the mine could be operated at all. I may say the mine was sold on a basis of something like 85 per cent. of the actual appraised value of the equipment in the mine. By driving some 1200 ft. of entries beyond the break, or fault, they got into coal of workable thickness. In doing that, many hundreds of feet of work was done that did not yield any result.

It did not seem fair to me to place the date of discovery and the values at the moment coal of approximately 40 in. thick was found. In setting up this value, which was a retroactive one, I took a date on which the company had blocked out sufficient coal for it to know that it was going to make money and eventually pay back the original investment in that equipment; which, if the mine turned out to be worthless, was nothing but junk. I think that the thing that we have to rely on in setting up these valuations is the absolute fairness of the men of the Department of Internal Revenue. In other words, if we make our case and show that we are fair, the Department will be entirely ready to meet us half way.

Mr. Armitage was discussing the necessity of some depletion rate different from the one determined for the total, or for the mine. If that problem were for me to meet, I should not hesitate to do it in this way. In making a valuation of a mine, an engineer will always place valuation on the various blocks of ore according to the quality of the ore and the probable cost of extraction. If these are not grouped before they are discounted, but are discounted to present value independently, according to some logical plan of operation, I believe that there would be no difficulty in placing values on the ore in each block or in each stope, if nec-

essary, and then with proper records kept, it would be perfectly possible to apportion the return of capital according to the actual difference in the cost of the ore. If we distribute the unit cost throughout the whole body of ore evenly, it is a fictitious unit cost, because we do not pay as much per unit for 2 per cent. as we do for 5 per cent. copper ore.

One other matter that has been of very great interest to me is the replacement fund. It is good economics and naturally we all want it. I think, however, it is necessary to consider, if we accept the dictum that a mining organization must be a continuing organization, what it is right to expect the government to allow us to perpetuate. Is it the actual value of the assets of the company? If so the present regulations meet the situation. Is it the earnings? In that case, the necessity of a replacement fund depends, not on the increase of cost of new deposits but on any change in ratio of income to costs of new deposits. Thus, if you buy a deposit now for more than it would have cost 10 years ago, you are no worse off because it costs more if it yields you a return proportionate to the increased cost. The third thing we might desire to perpetuate is the productive capacity of the organization; that is, the output of metal. If that is desired, it is necessary to establish some sort of replacement fund. That, however, involves almost insuperable difficulties in formulating an administrative regulation. It might possibly be done by allowing a revaluation each year and depletion on the basis of such revaluation with the idea that the newly deducted depletion allowance would be immediately invested in reserves. However, the regulations specifically say that there shall be no revaluation after once the valuation has been made and I think we need hardly waste our breath in trying to modify that, because there is a rather rigid determination to hold to that point; and, after all, is it not true that this increase in replacement costs is faced by practically every industry that we have?

Our railroads are facing the replacement of equipment at costs very much greater than they were 10 years ago; should they be allowed a fund to meet this? Should it be a depreciation on the basis of replacement cost rather than on the basis of actual cost? If that is done, should they be allowed to capitalize the depreciated cost, or should they not? There are a good many complications of that sort. The manufacturer is in the same position. He purchases raw material this year, manufactures it, and pays a tax on the difference between what that raw material cost him plus the cost of manufacturing, and selling price. He does not pay a tax on the basis of what it is going to cost him to replace that stock he used during the past year and I really question whether it is entirely fair to other tax-paying industries for the mining and oil industries to be allowed special consideration in the way of replacement funds.

CHAIRMAN ALLEN.—Mr. Brokaw's last remark suggests to me the importance in all discussions of this sort of keeping in mind the funda-

mental principle of income taxation. An income tax levies a tax on gains and profits. Gains and profits of mining are taxable just as the gains and profits of other industries and activities are. But capital is not taxable. The theory is that anything one owned prior to Mar. 1, 1913, is not taxable, only the subsequent gains or profits are taxable. From the income of the mine a certain portion representing a portion of the capital value on Mar. 1, 1913, is deductible each year as depletion. But this clause that we are discussing goes beyond the idea that only the income in excess of cost or of value as of Mar. 1, 1913, as the case may be, should be taxed. Congress realized, after years of study of income taxation, that mining is a peculiarly hazardous business and that mines should not be taxed on precisely the same basis as banks, for instance. This is a special relief extended by Congress to the mining and oil industries in recognition of the peculiar hazards in those industries. The extent of the relief and the manner of its application are left, wisely, very largely to the discretion of the Commissioner of Internal Revenue.

Those of us who were in the Bureau of Internal Revenue at the time the law was passed and who had to do with the interpreting of the meaning of that clause of the law tried for weeks to define the meaning of "discovery of mine," in such a way as to include everything that could be fairly interpreted as discovery and to exclude everything else. Pages were written on it and eventually consigned to the waste basket. You have the results of our combined labors in Article 219, Regulations 45. Perhaps by the time the experts in the Bureau have determined the taxes on some 1000 or 2000 mining corporations under the Revenue Act of 1918, they will have a much clearer idea of how that discovery clause may be applied equitably and fairly and will know more about what it means. We have not reached the bottom of this subject yet.

PAUL ARMITAGE.—The purpose of the clause in the 1918 law relating to discovery is to extend to the mining industry a help and benefit in certain emergencies; those conditions are the discovery by a taxpayer of a mine. The subject is very much clouded by a certain preconceived idea that we all have about the discovery of ore sufficient to justify the location of a claim. That is not what the law refers to at all. The Act says "In the case of mines, oil and gas wells discovered by the taxpayer." So, the taxpayer must discover a mine. He has got to discover a mine; nobody has a mine because he has discovered ore. The two words used are "discover" and "mine." Let us see what the meaning of those words is, for in order to understand the law those words must be given their ordinary meaning.

The word "discover" in its primary meaning means to uncover, to expose to view; that is the ordinary meaning. The second meaning is the act of finding out or bringing to knowledge what was unknown; a third meaning is "exploration."

Let us take up the word "mine." The first meaning of the word mine is "an excavation for digging out some useful product for ore, metal or coal." That is not the meaning used in this Act; in that sense, no mine is ever discovered. We never discover the excavation made for the purpose of digging out the product. The other meaning of the word mine is "a rich or productive source or supply;" in that sense, as when we say "a mine of wealth," it means a valuable deposit, a large deposit. This is the sense in which that word is used in the law.

It can mean nothing else than that for two reasons: In the first place, the law says that the value of the mine must be "materially disproportionate to the cost." To apply that, we must have discovered something which is of great value. How can we assert that it is disproportionate to the cost until we have uncovered something of value?

The second reference in the law is that the property must not be acquired as "a proven tract." It distinguishes between a proven and an unproven tract. Carrying forward these meanings, let us turn to the Act.

If we put these two words into the law, what have we got? We have the uncovering, the exploration of a valuable source or supply of ore; and until we have those things, plus the fact that it is materially disproportionate to the excess of the cost, we have not discovered the mine, in any sense of the word. Those things must exist before you can apply the law.

The only remaining question is: When have we reached a point of time when we can say, we have now discovered and explored a large or abounding source of ore materially disproportionate to the cost?

I do not really think in its practical application there is going to be any difficulty in determining that particular point of time in the discovery of any particular mine. As I take it, this is what usually happens in the case of a discovery of a body of ore. First, a person comes up on the ground and discovers ore and locates a claim; there is no discovery as yet. Then the capitalists, the mining men, purchase this unproven tract and start in to discover a mine; that is, explore the ore in that mine. That the law permits, because it says that until they purchase a proven tract the discovery provision is open to them.

The exploration proceeds continuously in almost all cases to a point where the operators sit down and say, "Now, we have a sufficiently large body of ore to start an operation, to build a smelter, to construct workings, to organize our force and go ahead." Until they have reached that point, they have not discovered the mine. In the vast majority of cases, that point is readily ascertainable. That is the time of discovery. In valuing that mine, you are not limited to the ore that you have exposed, but you can add to that ore a reasonable estimate of probable ore. It may be true that you may underestimate but, at least, you get

not only the value of your discovery, but your discovery plus the probable ore. The sum of these will be the value for the purpose of depletion.

If the Bureau of Internal Revenue will apply the law in this way, I think it will justly administer the law, and benefit the mining industry and give us the full benefit that Congress intends. I think it has already interpreted the regulations as meaning that. I do not think the question, unless the Bureau wants to modify or change its regulations, is really an open one. Art. 219 says,

The discovery of a mine or a natural deposit of mineral, whether it be made by an owner of the land or by a lessee, shall be deemed to mean (a) the bona fide discovery of a commercially valuable deposit of ore or mineral of a value materially in excess of the cost of discovery in natural exposure or by drilling or other exploration conducted above or below ground.

There is a definition exactly in accordance with what I believe the contentions of Congress were, as we interpret it.

The second part is that, "the development and proving of a mineral or ore deposit which has been abandoned or apparently worked out, etc." So I say that right in the regulations is the very definition of this discovery that we need. If we apply common sense to that in the history of each case, in determining a fair valuation of the property, I think that the law will be readily administered when the facts are laid before the Commissioner in each case.

CHAIRMAN ALLEN.—Assuming, for the purpose of further discussion, that Mr. Armitage has a fair interpretation of the meaning of the words "discovery" and "mine," after the valuation of the discovered orebody has been made, it follows, does it not, that the value of further additions to that ore in the ordinary course of mining is not to be added to the value of the property for purposes of depletion. Suppose that on Dec. 31, 1915, an orebody consisting of 1,000,000 tons has been developed and valued as a discovery. As years go by, the orebody is extended in the ordinary course of mining and 5,000,000 tons of ore are taken from it before it is exhausted. The amount allowable under this clause for depletion is the value of 1,000,000 tons and not 5,000,000 tons, is it not; in other words, a mere extension of known ore does not seem to constitute discovery within the meaning of the law. The regulations insist that no revision of the value shall be made after a property has once been valued for depletion purposes. There is a limit to the depletion allowance. You may prove that the orebody was much more valuable than was thought at the time it was valued but the valuation of anything as of a given date must take account only of those things affecting and determining value that were known at that date.

Take another case: Suppose that an orebody is discovered, measured,

and valued, and the amount set up in the accounts. At the time of this valuation, no other orebody is known to be on the property, but later a second orebody is discovered, quite apart, separate, and distinct from the one that had been earlier discovered and valued. Does the second orebody constitute a discovery of a mine? It may or may not be so located in the ground that it may be exploited from the plant already installed. It may be necessary to sink a new shaft and put in a new plant. It may, in fact, be a new mine in the ordinary meaning of the term. Is it a discovery in the meaning of this law? While it seems to me that the taxpayer is debarred from considering as discovered ore a mere extension of a known body, if he discovers a body of ore in no way connected with a body that had been earlier discovered and valued, if there is nothing in and about the first orebody or the property that would in any way suggest the occurrence of the second one, he has made a new discovery. The question is, is he entitled to the value of that second orebody for purposes of depletion?

Let us take another case: In the case of an adjoining property, suppose that one operator has developed the ore up to his boundary when the second operator extends his neighbor's discovery into his own property. Is the second operator entitled to discovery? Personally, I think not. The first operator's discovery extended to the boundary; the second fellow extended the other fellow's work. That, in my opinion, is not a bona fide discovery, for the law says that the taxpayer must make the discovery in order to benefit by it. So, it seems to me that if we start out with a clear understanding of what seems to have been the intention of Congress, to reward only the bona fide discoverer, and then consider the facts and circumstances of each individual case, it will be possible to come to some fair, reasonable, and equitable explanation of this clause with respect to the circumstances of individual cases.

If you will permit, I would like to raise another point in the law. Some of the speakers have referred to the unit method of determining the rate of depletion. I heard no commendation of that method; I heard some very severe criticism of it. Having established the sum that we may be permitted to set up on the books to be returned tax free out of earnings, at what rate is the sum to be returned? How much may we deduct in each year until the whole amount is exhausted? The regulations say that the best way of doing that is to determine the number of units in the property and divide the whole value by the number of units to arrive at the value of each unit. Multiply the value of each unit by the number of units mined during the year and you have the sum that you are permitted to subtract from your income of the year as depletion.

It may be that the income of the year may not be sufficient to take care of the depletion allowance for the year. Can you carry the balance over into the next year? May you write off on your books merely your

income, carrying forward into the next year the amount of depletion that your income does not take care of in order that you will be assured the return of the whole amount providing the property will pay it to you? It seems to me, gentlemen, that the law does not intend that the taxpayer shall be assured of the return of his capital provided only his property will pay it out. Many of you have a different idea. Therefore, we ought to discuss this matter.

It is necessary in the computation of an income tax to consider an accounting period. The law specifies the year of 12 months as the accounting period. The tax is assessed with reference to gains in that period. The regulations specifically instruct the taxpayer that he may not write off losses of one year against the gains of a succeeding year. It seems to me that if the income of the period of 12 months is not sufficient to take care of your costs, including depletion, you have lost part or all of the depletion allowance for the year. The deficit cannot be carried forward and subtracted from the profits of the succeeding year as expense or cost of the operations of that year. The law does not assure the keeper of a store that his capital invested will be returned to him. He is permitted and required to write off depreciation and other costs of the year, and no more, irrespective of the amount of his gains and losses. If his income is not sufficient to take care of his costs he cannot carry forward a deficit to the succeeding year and write it off as a loss.

May the rate of depletion be varied from year to year? I think it ought to be under some circumstances, and I think that the regulations partly cover the subject when they say that if a mistake has been made in the estimation of the number of units in the property, whether it be an overestimate or an underestimate, a revaluation of the unit of depletion may be made; such revaluation of the unit affects the rate of depletion. But this revaluation of the unit does not affect the total allowable sum for depletion. It is necessary, of course, to have some measure of the amount of depletion that may be written off from year to year. If the unit method of figuring depletion is not a good method, then what is a better method?

F. W. SPERR,\* Houghton, Mich.—I agree with Mr. Graton in his proposition that the value of mining property for taxation should be based on the price at which an expert valuator of mines would recommend the property for purchase to his client; for that makes it possible that mining property shall be fundamentally on the same basis as all other property as to method of valuation for taxation, which is as it should be. The tax assessor is presumed to know the value of property coming under his own particular assignment. In the mining business he is called

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\* Professor of Civil and Mining Engineering, Michigan College of Mines.

an expert. His basis of value is always, whether consciously or unconsciously, the price at which he would recommend the property for purchase to his client; and the valuation returned for taxation is usually at some fixed ratio to this price. Then for the same tax this ratio should be the same for all kinds of property, and all questions of differences should go before a special board of review for each particular tax, so that all property interests can feel that they are on the same footing in the matter of taxation. But, in the proposition to group mines for special methods of valuation, if I understand it correctly, I can hardly agree. It seems to me necessary to leave the valuation wholly to the assessor, the expert, if you please. It may be necessary and advantageous to classify mines and assign special assessors to special classes, but each assessor must be competent to pass on the values of the properties in his own assignment.

Hoskold's method of mine valuation was undoubtedly old among mining financiers long before it found its way into literature, and I have never known any fault to be found with it as a fundamental proposition; but as to the details of its application, there are sometimes greatly diverse opinions. Smock used the method in New Jersey many years ago, Finlay used it in Michigan more recently, and it is still being used in Michigan, for there is nothing else to be used. You cannot get away from it any more than you can get away from the method in use for finding the value of a perpetual annuity. But there should be uniformity in the application of details to each class of property. Then, no doubt, under the conviction that true valuations are at least fairly well approached, differences of opinion and charges of unfairness will largely disappear.

Furthermore, I believe that under such a system of valuations the anticipated difficulties with local taxation will be greatly minimized, if not altogether eliminated, because it will be possible to fix the ratio of tax valuation to actual price value the same for all property subject to the same tax.

C. H. BENEDICT,\* Calumet, Mich.—One point that has not been brought up is the question of the rate by which we shall establish the amount to be set up for the depletion account. I think some of us would rather question whether a mine, which has once been established and for which a proper depletion account is set up, would be considered more hazardous than the ordinary business enterprise in which a man pays the tax on the profit of his operations and is not permitted to set up a capital account. Everyone understands that if you consider mining a hazardous operation you should be entitled to a higher return on your

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\* Metallurgist, Calumet & Hecla Mining Co.

capital account. You are faced at once with the fact that if you are going to capitalize your earnings at a higher rate, you are going to have a lower amount to deplete.

I should like to know from Dr. Graton how they are going to steer the good ship between Scylla and Charybdis in this case. It is my contention that a rate of 6 per cent. on the capital is an ample return, in addition, of course, to such an amount set up that at that same rate of interest, 6 per cent. or 4 per cent. will finally return your capital. It is not my belief that it is necessary to establish a return rate of, say, 8 or 10 per cent. on the original capital. It appears to me that this is well worth discussing because on this is going to hinge the depletion value that you are going to be able to set up.

One example that I may give, where the hazard is a minimum, is a certain mine that is located in a lake. That mine is entirely developed, the records show exactly the tonnage of ore available, it has not been disturbed, and the values that may be recovered are fairly well known as well as the cost. What the selling price of copper is going to be is not known. I should like to know in a case of that kind, after correctly estimating the cost and the selling price over a period of 25 years, what would be done as regards a profit over and above the original property value?

L. C. GRATON.—I believe I understand Mr. Benedict, yet it seems to me that the Calumet & Hecla Mining Co. would not endeavor to reclaim and rework those old mill tailings unless a profit resulted from the operation. If they do derive a true net profit, it will of course be taxed. And in arriving at the present value of that tailings "mine," we must insert into the computation a reasonable rate of profit. I thoroughly agree with Mr. Benedict, however, in the view that their body of tailings, because of the minimum of risk attached to its recovery, should be valued on the basis of a relatively low interest rate, a rate perhaps lower than any other mining property that now comes to my mind. If money is worth 6 per cent. in a good sound investment, it certainly cannot be worth much over 6 per cent. in this very case.

You are entitled to know what is the attitude of mind on this subject of those of us in Washington concerned with mine valuation. We are not only young in that particular position but are relatively newcomers to this subject. We realize that it is a big and difficult one, even though we have to differ in that respect from the views expressed by Professor Sperr. The fact is, we have not endeavored to make up our minds as yet regarding proper interest rates for various classes of mines. We are gaining ideas on which to base decisions from these very discussions here, as I felt sure we would. If the Board of Directors of the Institute will appoint the special committee to confer and cooperate with us of the

Revenue Bureau, I feel confident that reliable results will be reached. So, for the present, at least, do not be alarmed lest we shall adopt interest rates that are too high to be just.

On the other hand, must not we who, I suppose, will have to make the final decisions, take properly into account that in the case of a mine, say the Calumet & Hecla, since it has been cited as an example, which has a long, unbroken profitable record behind it, its owners and operators will be likely to regard it more highly than most other people do? Will not their estimate of its worth and of the security of its capital presumably be tinged by their intimate knowledge of its dependability in the past? Will not its unusual and persistent prosperity, with which they have been so closely in touch and principally engrossed be likely to make them more optimistic toward mining in general than is justified by the average outcome in mining?

Clearly enough, the valuations that must be set up cannot reflect solely the owner's appraisal but must endeavor to reflect that price at which the owner and an intelligent prospective buyer would strike a bargain. On such a basis, I feel at present inclined to believe that the average buyer of mines, unable to efface entirely from his mind the memory of many a failure, would insist on a risk factor above the 6 per cent. standard in the case of even the best of mines. I do not attempt to say how much above 6 per cent.; and I realize that the argument I have just set forth must not be carried too far, for, as I have sought to establish in my paper, it must be recognized that the average profit-paying mine is naturally, and necessarily, worth more to its owner than to any one else. That this is actually true is attested by the fact that the owners of such mines rarely dispose of them. Therefore, it seems to me, a certain liberality must flavor the valuations.

C. H. BENEDICT.—I wish to add that I did not wish to be understood as saying that the Calumet & Hecla Co. did not expect to make a profit out of this operation. We did expect that the return would be no greater than what is represented by a tangible asset, as of Mar. 1, 1913, and therefore should not be taxable as income, but returnable as capital.

W. O. HOTCHKISS.—Mr. Benedict's example illustrates the point I endeavored to bring out, and that is a property which can be completely estimated. Let us make a few assumptions and make a concrete example of this. Assume that \$50,000,000 will be the total profit in recovering that copper, and that it will be received in ten yearly installments of \$5,000,000 each. At 6 per cent. discount with 4 per cent. sinking fund rate, the present value of this future profit is approximately \$35,000,000. At 12 per cent. discount, its present worth is approximately \$25,000,000. According to the discount rate chosen, one of these sums would be the "capital" on which a "depletion charge" would be based, and the re-

mainder of the \$50,000,000 would be profit on which income tax would be paid. If \$25,000,000 is taken as present value, the rate of profit will be 12 per cent. and the rate of income tax will be higher than in the other case where the capital is taken as \$35,000,000. In the first case, total profits (in addition to capital return, or depletion charge) will be \$25,000,000, which will pay a higher rate of income tax than the \$15,000,000 total profits in the second case. Now it is perfectly evident that the actual profits of the company are going to be the same no matter how we may juggle with "depletion" and "discount rate" and other abstract terms. The point is that it is of a great deal of importance to the company whether 10 or 6 or 3 per cent. is the discount rate taken to arrive at the present value. Furthermore, it is of interest that the higher discount rate resulting in the payment of the greater income tax is of advantage to the company when the matter of real property tax is considered, as the higher the discount rate, the lower is the present value.

R. C. ALLEN.—It seems to me that the decision with respect to the rates of interest to be used depends entirely on whether you choose to treat hazard as a function of interest. Most writers on the subject of mine valuation so treat hazards; but inasmuch as the valuation of a mining property, under the general method which is used by almost everybody who has to do with this subject in a practical way, is in the end a result of mathematical calculation, it is possible, if we choose, to eliminate the hazards in the weighting of the other factors and to use an ordinary rate of interest in reducing expected income to present worth.

Mr. Kelly, I am sure, will remember the discussions on this subject that arose in Michigan when the present system of taxing mines was started. The Michigan Tax Commission concluded that, with respect to the iron mines of Michigan, it is more logical to eliminate the hazards in the estimates of tonnage, cost, price, and life so that a uniform and moderate rate of interest can be used in all of the calculations of value. If in the calculation of value we treat all hazards in mining as a function of interest, it is necessary to establish a sliding scale of interest rates, to be applied to groups of properties and even individual properties in a group, in accordance with the actual hazards in the group or mine.

In the case of the Calumet stamp sands we have an illustration of the extent to which the hazards may be reduced by the precision with which the controlling factors of value may be estimated. The tonnage of sand is known; the copper content of the same is known; through years of experiment there has been developed a standardized method of extracting copper from those sands at a cost that may be estimated with precision. So, as Mr. Benedict says, the factors of valuation are well established. As a matter of fact, all of the factors that enter into the calculation with respect to those sands may be determined with a relatively fair degree

of precision. But compare the recovery of copper from Torch Lake stamp sands with the mining of gold in Cripple Creek. In the estimation of the value of a Cripple Creek mine all of the factors are uncertain save the price of gold.

The value of a mining property is, after all, not easily determined by arithmetic. The estimate of the value of a mine is an application of human judgment and it seems to me that the Bureau must be free to exercise its judgment in each individual case as well as with respect to a group of similar mines. No one set rule or method may be devised that will apply equitably to all mines even in a single district or large group unless it be so elastically constructed that in its application it amounts to the use of alternative methods based merely on the common general principles that underlie the estimation of value of all expectations of income from wasting natural resources whether it be from a mine, oil well, tract of timber, bed of marl, or clay bank.

E. P. GRIFFITHS, Chicago, Ill.—It seems to me that your discussion of this matter has possibly been from a narrow point of view and that you are forgetting some things that are allied to this matter. You say the mining industry is one of hazards and, yet, are you the only ones who received the government questionnaire? I spent an afternoon about two weeks ago with the president and the secretary of the American Pulp Association, who had this matter on their minds in behalf of the industry and were about to appoint a committee to consider the same subject. That same evening I spent several hours with a finisher of very fine textile fabrics, and he had the matter on his mind. He said "There is nothing standard in our business. Overnight the converters may get it into their heads that there must be a different kind of finish for fabrics." You have been talking about hazards of the mining industry. I do not see that your business is any more hazardous, generally speaking, than almost any other business. If you furnish 50 or 75 per cent. of the tonnage to the railroads, you are putting the railroads in a precarious business, if your business is hazardous. One of the speakers said he thought the matter ought to be handled the same as any assessed value, or like real estate. I think he did not fully realize that in this matter we are in a much more favorable position. We are going to be asked to assess ourselves, to assess our own property. If the government furnishes anything, it will be a formula for us to apply.

W. O. HOTCHKISS.—Most of the discussion has concerned itself with what, in point of numbers of mines, is of importance to an exceedingly small minority of the mining people in the country; therefore our experience in Wisconsin may offer some suggestive points and lead to further discussion.

When the Legislature turned over to the Geological Survey the task

of determining the values of the mines of the state for assessment purposes, we undertook to apply to the zinc mines of Wisconsin the same methods of valuation as had been applied to the iron mines in the northern portion of the state. But in one year insurmountable difficulties were encountered. We would prepare our figures of valuation in the spring-time—our assessment date is May 1—but by June a given property might be exhausted and have no value, while another might have run into a new orebody, and doubled its value or perhaps increased it ten times. That one year's experience proved to us the impossibility of applying the method of present value of future profits to the small, short-lived property. It is absolutely impractical.

The development of an orebody there began with the drilling for the zinc, which was carried only to such an extent as to develop a body of ore that would, with reasonable certainty, guarantee the cost of erecting the mill to treat that ore and sinking the shaft. Any profit received came from pure good luck in the extension of that orebody farther than the drilling had shown. In almost no case was there a mine in that section of the state which had visibly before it six months of life, and yet the average life of those properties would be between four and five years.

It was absolutely impossible to value those mines by discounting to present value the expected future profits, so it was necessary to draft legislation providing for a certain percentage of the revenue derived from the operation of that property of the preceding year as the basis of taxation for the succeeding year. In the vast majority of mines that are now going to be taxed under this federal income tax law, that same difficulty will present itself.

The small mine never has an assured tenure of life ahead of it that will warrant a valuation such as you may expect from the basis of averages in the district. Such district averages and forecasts can be made with much accuracy in many cases, but it is wholly unjust to apply to any individual mine an average figure for the whole district. That mine may come up against a bar 20 ft. ahead of the breast of the ore at the time you assess it and the orebody may absolutely disappear. On the other hand, it may go for  $\frac{1}{2}$  or  $\frac{3}{4}$  mi. No one can tell which it will do.

Any logical viewpoint of the valuation of the property of that sort for purposes of purchase or assessment is going to mean that the taxing official must put himself in the frame of mind of a possible buyer of that property. What is he willing to say is a fair sum that he could risk on that property individually and obtain his capital back with interest? To do his job rightly he should be blessed with a foresight that would make him the envy of the whole mining profession.

I do not see how the present federal income tax law can be made to apply logically to that type of mine. When we began our studies we

considered as absurd the methods of taxation adopted in many of the western states, in which they took a certain proportion of the yearly gross, or net, proceeds from the property as a basis of the tax. But after the most careful study we were driven to adopt the same plan. We still continue to value the iron mines of the state by the method of present valuation of the expected profits, and it works to the satisfaction of everybody concerned. These other properties, for a considerable number of years, have been taxed on a certain percentage of the preceding year's income.

JAMES J. FORSTALL, Chicago, Ill.—There is one question in connection with the income tax, materially affecting mine owners, which has not been even touched on here. It is the question of the taxation of increases in capital value. Under the Sixteenth Amendment, can you tax, as income, an increase in the value of capital merely because it has been turned into cash or some other form of property? That is of great importance to mining concerns where property has been bought for a small amount and sold at a tremendous increase. I would be interested in a little discussion as to what thought is being given to that question. It really seems that the Supreme Court of the United States would have to decide that such an increment is not income and cannot be taxed as income.

Take the case of a mine that is put in trust, the income to be given to certain people and the remainder, after the death of these people, to go to some one else. If that property was worth \$100,000 at first and was later sold by the trustee for \$200,000, it is perfectly plain that the additional \$100,000 would have to be kept intact as part of the principal of the trust estate and would not be income. If such a case came before the Supreme Court it would certainly so hold. Could that court, then, in the same breath, say that the government can tax this additional \$100,000 as income under the Sixteenth Amendment? It is an interesting question, one that is well worth careful consideration.

THE CHAIRMAN (A. D. BROKAW, New York, N. Y.).—I think there is no question that one of the greatest objections of the present law, and more particularly the 1916 and 1917 laws, has been the prohibition of sales on account of the enormous taxes involved, particularly in the case of sales by individuals in process of consolidation. I am interested, indeed, to know that there is even a question as to the constitutionality of the income-tax law in assessing tax on incomes derived from increasing value of property.

PAUL ARMITAGE.—Is all property taxable where part of it had arisen before Mar. 1, 1913? Suppose a man purchased property for \$100,000, 10 years before 1913, and sold for \$200,000 5 years after 1913; is that all

profits which he has earned since the income tax went into effect, or would two-thirds of it be considered as coming in before the income tax, and one-third on the income tax?

CHAIRMAN BROKAW.—That is covered in the regulations, by an appraised valuation.

PAUL ARMITAGE.—I think if the property was purchased after Mar. 1, 1913, and sold at a profit, that profit would be taxed. There might be a question as to what rate it would be taxed.

R. C. ALLEN.—Suppose you buy a lot today for \$500 and a year from now it is worth \$5000; there has been an increase of \$4500. That is an increase of capital value. In essence, it is the same thing as putting back your current earnings into the equipment and development of your mine. In both cases there is an increase in the capital value. But in the latter case the earnings of the year are realized in money and taxed before they are reinvested. In the former case no tax is paid on the appreciation in value from year to year because the appreciated values are not realized in cash or equivalent income. Under the income tax law since Mar. 1, 1913, the road to earned surplus runs through the income account and no addition to earned surplus can be made except from income. Therefore, in the former case no addition to capital account is permissible on account of appreciated but unrealized value.

W. O. HOTCHKISS.—I would like to ask Mr. Allen how that policy would agree with the policy of revaluation on new discoveries in the mine?

R. C. ALLEN.—Formal claims have been made in connection with tax returns at Washington for the addition to capital invested of the value of current discoveries of ore. If the appreciation in value is not income, it cannot be capital, because before it can be capital it must be income. For the tax purposes it is neither income nor capital. Perhaps I can make myself clear. We will start at the beginning of the year with 10,000 tons of ore. In the course of the year we run out 5000 tons but discover 50,000 tons. Is the newly discovered 50,000 tons to be considered as capital invested? There is an appreciation in the value of the property equal to the value of 45,000 tons of ore; but that value cannot be taken into surplus until it is realized in money, passes through the income account and pays a tax.

The point of view of the administrative authorities seems to me very logical; it is that the discovered ore is neither capital nor income. It may be added to capital only through income, *i.e.*, when the income is realized from the exploitation of the discovered ore. I have never been able to understand how you can add to capital in this way except through the income account. It seems to me that unless we abandon the basic principle of the income tax, we have got to consider the appreciation of

value of property as income if we wish to consider it as capital. A more logical view is that it is neither income nor capital for tax purposes until it is actually realized.

The practical method of measuring the extent of gain or loss is through a transaction involving change of ownership. That is the ruling of the Department—it is a very reasonable thing. I would like to cite a case. If I remember correctly, an Alaskan mine was flooded by the sea a few years ago and is worthless today. A gentleman came into the Department one day who owned considerable of the stock in that mine. He told of the destruction of the mine and said that he had tried to sell his stock in Europe and in this country but that no one would buy it. "I have sustained a loss and want to write it off in my income-tax statement," he said. He was told that he must sell the stock even if he had to sell it for 25 c. before he could determine the extent of his loss. Is not that a reasonable ruling on that matter? It may not appear to be at first thought, but careful consideration will convince one that as a practical matter in tax administration the ruling is wise and necessary. Without it endless claims for indeterminable losses would be made.

**WILLIAM KELLY.**—Is it necessary to make a sale before you can compute income or loss of income? You cannot consider income as a matter of appreciation of value unless it is sold?

**R. C. ALLEN.**—In the case cited the fact of depreciation is of course apparent before a sale of the depreciated property takes place but the amount of the depreciation in value may be measured only when the property is sold.

**L. C. GRATON.**—One of the questions which interests me particularly is whether it will be possible, in order to handle the thousands of mines to which values must be assigned, to treat them in groups or whether we must burn the midnight oil, in every sense, and take them up individually. Some appear to feel that the group plan is unworkable. This question has given me much concern, partly, I confess, because I cannot stay in Washington very long, yet I do not want to leave with the job little more than begun. I believe if we look the matter fairly in the face we will agree that the group method is likely to be the one adopted.

We all realize that settlement, decision, of these taxes for back years is becoming, if anything, more important than the size of the tax. Many things that ought to be in motion are drifting or at a standstill because of present uncertainty regarding taxes. Now would you not prefer to have us group you together in classes and then put you by handfuls approximately where you belong, rather than to pick each one of you up separately, turn you over and over, determine and describe all your individual differences—and all of us die before the job is anywhere near com-

pletion? The group method then, maintaining necessary elasticity and with a willingness always to pursue special conditions as far as they ought to be followed, must, I believe, be the procedure adopted.

One more word about interest rates, if you please. As Mr. Allen has suggested, there are other ways of providing for hazard than through the rate of interest return. Yet I am inclined to favor this last method, for this reason. In this complicated problem of taxation, we are liable to wander far from truth and sense if we do not apply this test to practically every step we take: is this the direct, business-like, normal way of doing this thing? Now in the matter of investments, there is one standard, conventional, and thoroughly understood manner of reflecting risk, and that is through the interest return. We consider nothing so secure, so certain to protect principal and to pay interest as a government bond, consequently nothing yields so low a rate of income. A good mortgage on real estate returns  $5\frac{1}{2}$  to 6 per cent. A mining company's bonds, as Mr. Brokaw has said, ordinarily yield less than the same company's stock because the bonds are better protected. I fear that if we were to depart from this recognized method, we might soon find ourselves adrift in unknown surroundings, and in any event our findings would be meaningless to those not conversant with the details of mining.

We can all sympathize with Mr. Hotchkiss over the difficulty of placing valuations on small, erratic, short-life properties, like the zinc mines of southern Wisconsin. Yet such properties change hands—indeed they are among the commonest types of mining property to be bought and sold. And each sale indicates that buyer and seller agreed on a valuation. How do they arrive at it? In this way: each tries his best, consciously or unconsciously, to estimate what the property will yield, then each, consciously or unconsciously, capitalizes that expected return; finally they dicker until any difference between them is eliminated. This method of capitalizing income is always the basis, and the aim toward which all valuation of fixed property approaches.

Mr. Hotchkiss, with his legislature geographically and objectively available and amenable, was able to avoid the difficult job of valuation by securing laws applying taxation on a different basis than that of value. But, the federal government is probably too deeply committed to the principle of tax on incomes to be diverted from it by a difficult, though I believe not insoluble, problem in a single industry. Furthermore we must not forget that the conditions to which Mr. Hotchkiss has referred are not confined to mines of small output and short life. There are numerous great mines of long history, and no doubt long future life, which raise identical problems. I refer particularly to deposits in altered limestones.

H. S. COOPER.—How are you going to develop your valuation of them?

L. C. GRATON.—It will be necessary, I believe, to put them up alongside mines whose value can be measured with greater certainty, then factors must be established that will harmonize the valuations for the two classes. It is difficult, but I believe not impossible.

Mr. Griffiths, who feels that mining is no more risky than many other businesses, I am sure we were glad to hear, as bringing to us a point of view from the outside. For I conceive that, although the mining industry is big, we might easily become narrow-minded if we confined our views to its limits. We want to keep in balance, not only within the industry, but in proportion and perspective to the other industries and activities of the country.

I want to say to you in all sincerity and seriousness, that if there be any merit or advantage in the plan of the Revenue Bureau of attacking the problem of mine taxation in a specialized, engineering fashion, there is one man more than any other who is responsible for it and to whom the credit for it is due, that is, Mr. Allen. It is to be regretted that he could not have been persuaded to remain in the Bureau and run the ship.

H. M. LA FOLLETTE,\* La Follette, Tenn. (written discussion†).—The admirable spirit of fairness shown by Mr. Graton in his very complete presentation of this broad and most important subject must command the approbation of all. The far-reaching effect of the recent extraordinary application of the income tax, including the graduated rates applied as "excess taxes," involves many possibilities of indirect stimulation of both development and abandonment of large fractions of the values involved in mining operations. The dangers involved in its application to incomes from mines and other self-depleting industries are of gravest concern to all who appreciate the far-reaching effect upon our country of the proper preservation, replacement, and complete reclaiming of the full values in these industries which are, at best, constantly sacrificed or largely lost by reckless or incompetent operations, without the added motive of avoiding excessive taxation or increasing the immediate output at the expense of the ultimate production.†

Income produced as the fruit of mechanical invention, as well as of the wise and skillful administrative ability of the citizen far more than from invested savings or other funds as principal previously acquired, are necessarily subject to all income taxes, as much as are fixed incomes from vested funds or estates; but that fact is an added reason why "excess income taxes" need to be placed with caution and due care not to carry such levies to a confiscatory limit. The only justification of "excess taxes" is the absolute necessity of the state for self-preservation. While

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\* President and General Manager, La Follette Coal, Iron and Railway Co.

† Received Nov. 7, 1919.

the principle of taxation of incomes is possibly the most just rule applicable to taxation and, by the adoption of the Sixteenth and Eighteenth Amendments to our national Constitution, is to become permanently the foundation and chief source of our government revenues, there is reason to believe that some tax legislation and administration are being subtly advocated and applied not so much for the true and wholesome needs of the state and the protection of constitutional rights and liberties as for the establishment of socialistic fundamentals and doctrines of virtual confiscation of property.

I believe it is a question of supreme moment to patriotic Americans whether the socialistic tendencies of a small but vociferous minority, promulgated through what Col. Henry Watterson has so well described as "our chattering ragtime press," are not in danger of securing through tax laws, passed under the guise of patriotism and a claim of "social reform," a misapplication of the ends of the state and creating political conditions in direct conflict with the letter and spirit of our national Constitution and the fundamentals of our republican government. We must never forget that our government and Constitution were established for the equal protection of the lives, liberties, and properties of all our people, that the Fifth Amendment expressly declares that none "shall be deprived of life, liberty, or property without due process of law; nor shall private property be taken for public use, without just compensation;" while the Fourteenth Amendment explicitly makes it the duty of every state to equally protect the life, liberty, and property of every citizen. So, in the application of the income tax to mineral production, there must be considered the general principles involved, the urgent and reasonable necessity of the revenues to be thus derived, and the grave danger that excess taxation laid upon mineral production may either destroy, to some extent, the source of income or lead to the permanent loss of extensive deposits by not conserving them as a whole and, so to speak, making the rich sections pay for the mining and saving of the lean sections which in many if not in a majority of cases, comprise the major part.

Substantially all conditions that govern assessments of mineral property for direct or local taxation should be considered in determining the method of applying the income tax, as Mr. Graton has pointed out. Distinction must be made between the ownership of land and "mineral rights." In seven states coal-leaseholds are specifically exempted from taxation; in eight states they are, by peremptory statutes, made a base of taxation more or less specific. In Wyoming, the law fixes tonnage values of 60 to 95 c. based upon quality of all production. In Kentucky, the only direct tax laid upon oil property (production and [improvement]) is one-half of 1 per cent. of the market value of oil as shipped, payable to the county. Thus at the rate of its current receipts, Lee

County will receive within this calendar year over \$100,000 of oil taxes. In two states, laws providing specific taxation of standing timber had to be repealed to prevent the complete denuding of their forests. The assumption that coal is of uniform thickness and quality, and that an average may be reached by estimation, has often proved outrageously unjust. In the anthracite region of Pennsylvania, assessments per foot-acre have varied from \$9.84 to \$250 and even \$300 for direct taxation of faulty territory that in some cases yielded gross less than the cost of mining. If the enterprise of operators in drilling and testing coal land invites excessive assessments, the inevitable result is that such enlightening tests are omitted and the operator relies upon the almost universal legal rule that the lawful value of untested mineral land is the cash price at which the land can certainly be sold.

My own experience has been chiefly in the field of iron ores and bituminous coal. The great bulk of our iron ores consists of hematite ores, red and brown, which have always shown wide variations in quantity and quality, especially the brown ores which notoriously fail in a majority of cases to yield upon the average more than a small fraction of the quantity indicated by the surface exposures.

In the case of coal values, the rule generally accepted and practised in a majority of the coal states is that laid down by the Supreme Court of Pennsylvania (Pa. S. C. R. 229, p. 470) as follows:

Its market value is its fair selling value for cash, not payable as royalty strung out through a long series of years, but payable at the time or as soon thereafter as the value can be determined \* \* \* \* The question is not what earning power coal lands may develop in the future, but what they are actually worth in the market at present.

But while unpaid royalties are not a reasonable basis for direct or local taxation, in determining income taxes whatever royalty deduction is allowed a leaseholder should be credited uniformly and be deducted from the "net income" of the operating owner in fee.

That the best ultimate interest of the public and of the future supply and consumption of any mineral will be served by virtual omission of attempted valuation of invisible mineral believed to remain in the ground, and by the assessment in some form (whether for local taxation or Federal income taxes) on the year's output at actual sale prices received at the mine, with deduction for full mining cost, depletion, depreciation of equipment, and other deterioration, if any, would seem to be self-evident.

All must agree that excessive assessment or overtaxation (whether direct or upon income) of many extensive deposits of coal and iron ores, which should ultimately yield an enormous production to the great benefit of the country at large even if with small profits to the operators, must inevitably lead to the destruction and permanent loss of the greater portion of such deposits, by the mining of the most valuable portions

and such fractional parts or veins as can be most cheaply mined, leaving the great bulk of leaner mineral in the ground under conditions that prohibit profitable mining.

In applying income taxation to products of such properties consideration must also be given to the exceptional provisions in the constitutions and laws of the particular states. Thus in the constitution of the State of Tennessee there is a specific prohibition of taxing any Tennessee product while it remains in the possession of the original producer. This exempts from taxation virtually nearly all personal property on the farm as well as pig iron, ores, coal or coke on the yard, felled timber, manufactured lumber, etc. so long as owned by the producer. Combined with the further exemption to all taxpayers of \$1000 of personal property, of whatever kind, these provisions in the original constitution of 1797 have made it impossible for "modern reformers" to displace that historical instrument, though frequently attempted, except by minor amendments that do not affect these provisions that favor all producers, miners, manufacturers and farmers alike. After all, it is not a bad constitutional provision! But it must be recognized as a general rule that only the most fair and liberal application of heavy income and excess profit taxes upon mine products will avoid the grave danger of driving the mine operator in many cases to "hog" his mine, by working out only the richer sections and leaving all leaner material in such shape that it will be permanently lost.

### Correlation of Formations of Huronian Group in Michigan

Discussion of the paper of R. C. ALLEN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2579.

ALFRED C. LANE, Tufts College, Mass. (written discussion\*).—The attention of members may well be called by Allen to his discoveries, which affect not only correlations in Michigan but, as I have pointed out,<sup>1</sup> the use of names like "Animikie" which are widely applied. It shows that one disadvantage of the wide use of locality names is that local discoveries may show that they are inappropriate. The Wewe hills were found not to contain the Wewe slate! So we note that Allen, in his correlation, drops the term Animikie, which his researches indicate covers both middle and upper Huronian.

It would seem well, then, in dividing the Huronian or Proterozoic, to use, as Allen does, terms like upper, middle, and lower Huronian, or newer, middle, and early, which may be shortened into eo-, mio-, and neo-Huronian rather than to carry local terms far away; or we shall soon be

\* Received Sept. 19, 1919.

<sup>1</sup> *Science* N. S. (1915) **42**, 869 and *Am. Jnl. Sci.* [4](1917) **43**, 42.

in the condition of the zoologist, who has to add to a name the author whose usage he follows.

Comparing his correlation with previous attempts, as that of Lawson,<sup>2</sup> we find general agreement so far as the heavy dolomite of the eo-Huronian, so widespread and thick that its correlation is fairly easy. If, indeed, it marks the first efflorescence of lime precipitating vegetation, as the Carboniferous marks the first great efflorescence of higher vegetation, it may possibly be correlated throughout the world.

The heavy iron formations Allen places in the mio-Huronian, but they are supposed to be equivalent to the Animikie iron formations of the north side of Lake Superior. If this period marks the first great efflorescence of the iron precipitating forms, such as those recently described,<sup>3</sup> it, too, may be traced over the world. Allen makes, however, within the mio-Huronian two iron formations, the Traders and the Curry. A recent letter from Iron Mountain tells me that the existence of a separate Curry member is still doubtful.

There is one thing that makes it hard to be sure of the stratigraphy, worth remembering: block faulting and block fault mountains, if followed by a period of folding and granitic intrusion, are very hard to recognize. They are even more hard to prove and may produce apparent repetitions that are not real. It is noteworthy that the early Lake Superior monographs paid little attention to faults in the Huronian. It was in the "zone of flow." And yet to get there and back to the surface it must twice go through the zone of fracture. Allen rightly recognizes much more faulting. So does Collins.<sup>4</sup> Still more will be found.

It is noticeable that Lawson's term Algoman, as applied to a mountain building interval between the neo-Huronian and the mio-Huronian, or as he calls them Animikian and Temiskamian, is not used by Allen. Now it is true that a number of the granites which Lawson placed with the Algoman, the Killarney, and Moira, for instance, belong later and Collins thinks them Keweenawan.<sup>4</sup> Allen seems to put this group of granites later than the youngest Huronian sedimentaries, just before the Keweenawan. There are, however, at least two times in the Keweenawan when wide extended effusions of porphyries suggest the stirring of granitic magmas on a large scale, and one is reminded of the conditions around the harbor of Brest in France, where Barrois<sup>5</sup> points out that the effusives

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<sup>2</sup> A. C. Lawson: University of California Publications, *Bulletin of the Department of Geology* (1916) 10, 1-19, reviewed by me in the *Am. Jnl. Sci.* [4](1917) 43, 42, with his correlation plate marked over in free hand to show suggested changes.

<sup>3</sup> U. S. Geol. Survey, *Prof. Paper* 113.

<sup>4</sup> W. H. Collins: *Geol. Sur. Canada, Mus. Bull.* 22 (1916) and private communication from him and Morley.

<sup>5</sup> Ch. Barrois: *Guide Géologique de France*, Part VII (Bretagne) *Internat. Geol. Congres* (1900) 17.

south of the harbor, including Kersantite dikes and a luster mottle ophite much like the Keweenawan ophite and the kersantites "are limited to Carboniferous synclinal regions; they are replaced, in the neighboring anticlinal regions, by massifs of grained (plutonic) rocks which represent the profound reservoirs of them." However, it may be that the relations of these granites and the Keweenawan are like those of the Late Carboniferous granites and the Triassic of the Atlantic coast. It must be remembered that I believe the Keweenawan is more or less Cambrian, and the discovery by Watson and Cline of amygdaloidal basalt that might well be Keweenawan in the Lower Cambrian of Virginia<sup>6</sup> at least weakens the argument of Van Hise and Leith<sup>7</sup> that the Keweenawan is pre-Cambrian because the Cambrian is "lacking volcanism."

But, I should not be at all surprised to find the Keweenawan composite, as the "Redbeds" have been found to be out West, yet it seems hardly possible to think that all the granites which Lawson classed as Algoman can be crowded into the Keweenawan or immediately pre-Keweenawan. The Presque Isle granite, which is pre-"Coppes," must be placed in the "emergent interval" between the Hanbury and the Loretto, must it not? In that case the two "emergent" intervals separating the Huronian, while they may not be marked by granite intrusion and mountain building in the Menominee district may have been, and I believe were marked by these actions in other districts—actions that produced the widespread eustatic change of sea level, registered in the Menominee district. I am inclined to think that at least as near as Humboldt and Republic one will find granites and basic effusives and dikes corresponding to these periods of disturbance, and I think that in the Menominee district, also, dikes and faulting belonging to these periods rather than to the epi-Huronian will be found.

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### Value of American Oil-shales

Discussion of the paper of CHARLES BASKERVILLE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 957.

ARTHUR L. PEARSE, London, Eng. (written discussion\*).—In the last paragraph Professor Baskerville correctly sums up an important position. The paper was probably written some months ago, as is indicated; if it were written today he would have further emphasized these conclusions. The oil-shale is a great industry, has been for many

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\* Received Oct. 14, 1919.

<sup>6</sup> T. L. Watson and J. H. Cline: Extrusive Basalt of Cambrian Age in the Blue Ridge of Virginia. *Am. Jnl. Sci.* [4] (1915) 39, 665.

<sup>7</sup> U. S. Geol. Survey, *Monograph* 52, 416, line 5.

years, and bids fair to become one of the most important. This industry and its twin—the carbonization of coal—are the most important unorganized industries in the world today.

We are not precise enough when we talk about the Scotch shale-oil practice. If reference is made to the system of retorting that reached an assumed standard some 10 yr. ago, I would say that no one would build such retorts today; but they are good enough to wear out and there are more of them in Scotland than there is shale to keep them going. If the reference is to the Scotch system of treating the oil, evolved out of much experience and generally adopted as standard 6 yr. ago, I would say that this method has been replaced by fractional distillation and cracking plants. The old Scotch retort is not the best to use on either American or any other shale. The adoption in the latest English plant, of which the first unit is 1000 tons daily, of an entirely different retort proves this.

Principally owing to better practice, evolved out of work on the carbonization of volatile coals and other hydrocarbons, to say nothing of shale, we have learned a great deal. With the exception of the cases when the carbonized residue is required in such shape as metallurgical coke, for instance, and for which the coal or material is primarily treated, all the older methods of carbonization in ovens, intermittent or continuous verticals, etc., and where mass carbonization is adopted, are obsolete. By mass carbonization is understood the heating of a body of material, the particles of which are in close contact with each other, in contradistinction to a condition in which each particle is unconfined. Mass carbonization involves the passage of the heat units from the wall of the retort into the center or through the charge; as this action proceeds, it sets up the best heat screen with the corresponding costly results. This is why the consumption of heat is so great in coke ovens or vertical retorts. The act of carbonization under proper conditions is almost instantaneous. The aim of modern designers is to approximate this condition. It has been proved that, provided the gases are properly taken care of, the product is better and there is more of it. Besides, if gasoline, or motor spirit, is a desideratum, the faster the carbonization, the better the spirit, for the destruction of olefines is less, especially at low and similar temperatures.

It must not be forgotten that the whole tendency of destructive distillation, or as an authority has recently named it, "constructive" distillation, is toward lower temperatures. In the United States 700° F. is used by one plant as its standard; while in England 600° F. is used with the best of results; but these temperatures necessitate other considerations if a reasonable recovery of ammonia is required.

The adoption of the principles mentioned have resulted in low first cost per ton-day for retorts because the "through put" is greater owing

to better heat application. The amount of heat used is one-third less and the quality of the product is better, for the gases are withdrawn nearly as and when evolved.

While the retort has been the most serious question to many, the disposal of the gases has also been troublesome, especially where there is a shortage of water. The ponderous and, usually, leaky air and water condensers formerly so universal have been replaced, even in Scotland, by systems of fractional condensation, whereby the products are taken down in nearly the fraction or fractions desired. The cost of this section of a plant is practically cut in half and so is the trouble and expense of running.

A big through put, or divisor, is essential to the best plants; the necessary capital involved, even for a Scotch plant, was enormous, and the plant was very complicated. Today the cost of a modern plant can be reduced to 70 per cent. of what it would have been 2 yr. ago and at least the same reduction can be made at the operating end.

Although a great deal has been done toward cheapening and simplifying the process of carbonization, Professor Baskerville is right when he warns us that it is an industry requiring capital and skill. There are many angles and many economic conditions to be considered; not the least of which is "distribution." Notwithstanding all these, it may now be safely assumed that it is quite as easy to distil oil from shale as to drill for and distil oil for its products, and on the whole it will be quite as profitable commercially.

E. A. TRAGER, Bartlesville, Okla.—I have distilled something over 800 or 900 samples of western oil shales and find that it is possible to get different products by different types of distillation. I have also found that by the same method of treatment the shales are divided into different groups. One type of shale tends to yield gas almost entirely; the majority of them yield mostly oil; while there are some that give a good yield of both gas and oil. This summer I found a type that by dry distillation will yield B. S. almost entirely.

THE CHAIRMAN (C. W. WASHBURN, New York, N. Y.).—What conditions do you find give the best results in distillation?

A. W. AMBROSE, Washington, D. C.—The matter of heat control is perhaps one of the biggest factors in determining the quality of the different byproducts.

E. A. TRAGER.—You can produce all gas and no oil from any shale by heating too rapidly, but as near as it is possible to tell, by a uniform method of distillation the different shales will divide themselves into different groups, this division being based on the resultant products.

A. W. AMBROSE.—Did you try any experiments by grinding shales to different sizes?

E. A. TRAGER.—Yes; but the size does not seem to affect the product. We tried everything from  $\frac{1}{2}$  in. mesh to  $\frac{1}{200}$  in. mesh and the product is very much the same. The method of heating is the important factor.

CHAIRMAN WASHBURN.—It is very evident that this matter of distillation of oil shales is something for our grandchildren, possibly our great-grandchildren, but let us hope that scientists will begin to study the problem so that the next generation may have some good out of it. I believe that there has never been any gasoline or kerosene of good commercial quality produced from our Western oil shales in any quantity. The best American shale, with the best method we have, would take too much sulfuric acid in treatment. What little first-class oil would be left after the treatment would not pay for the cost of the operations.

E. A. TRAGER.—I found some oil shales that yield from 30 gal. to 60 gal. per ton, which on distillation will yield about 23 per cent. gasoline and 33 per cent. kerosene; this was treated with  $H_2SO_4$  and the loss wasn't very great. The samples of shale which contain only a small amount of oil yield a low grade of oil; while at the same time, the better shales will yield more oil and contain a larger percentage of light constituents. The best shales which have been found to date come from Colorado. The gasoline is apparently of very good grade but the great objection is the offensive odor—it is very undesirable—just what it is, I don't know.

CHAIRMAN WASHBURN.—Does that last remark apply to most oil shales in Colorado or to just a few samples?

E. A. TRAGER.—It applies to all Colorado shales. We have studied quite a number of samples and in every case the shale that yields a low amount of oil will yield a heavy gravity oil. Some of the crude shale oil is quite light; the first of the yield looks somewhat like the old fashioned kerosene. It is only the odor you will have to contend with.

R. A. SMITH, Lansing, Mich.—Mr. H. A. Buehler recently told me that a new type of retort for coke manufacture has been developed by G. W. Wallace of the St. Clair County Gas Co. of East St. Louis, Ill. This retort has been found to be especially adapted to oil shales. It is entirely different from the standard types in use at the present time. Coke is produced in 4 hr. and the treatment of oil shales is completed in about the same time.

### Recording Thermocouple Pyrometers

Discussion of the paper of LEO BEHR, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1655.

R. W. NEWCOMB, New York, N. Y. (written discussion\*).—In this paper, the author has enumerated the various sources of error that may, under certain conditions, develop in instruments of the direct-deflection type, but through a failure to mention possible sources of error in instruments of the potentiometer type, he leaves the reader with a wrong impression. If he would carry his criticisms further and give a list of the possible sources of error on potentiometer instruments, the paper would be more complete.

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### Determining Gases in Steel and the Deoxidation of Steel

Discussion of the paper of J. R. CAIN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1309.

SAMUEL L. HOYT,† Nela Park, Cleveland, Ohio (written discussion‡). The work that Dr. Cain is doing on gases in steel should have a highly important bearing on investigational work in connection with steel-making practice. We found, for example, in our work in connection with the use of manganese in open-hearth practice that we needed expressions for the manganese efficiency and the "condition" of the steel. To get these figures we assumed that we would need to know the amount of FeO at different stages of the heat and the amounts of the gases present. This required simultaneous analyses of our samples for FeO and the gases and Dr. Cain seems to be the only investigator who has considered the analytical work from this point of view. That he has done so is very encouraging and it is to be hoped that his work will solve the mysteries now surrounding this neglected phase of steel metallurgy.

Those interested in the Ledebur method for use in connection with the efficiency of manganese as a "deoxidizing" agent will be disappointed to learn that more recent work at the Bureau indicates that Ledebur determinations are not reliable. The principal source of error seems to be due to the partial reduction of the ferrous oxide by the carbon present in the steel. However, it seems like an unnecessary criticism of the Ledebur method to state (p. 1319) that it proved of little value because it showed little differences in oxygen for a series of steels treated with various reagents and showing variations in physical properties and free-

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\* Received Oct. 15, 1919.

† Metallurgical Engineer, Experimental Engineering Laboratory.

‡ Received Oct. 30, 1919.

dom from blowholes. One would hardly expect to find appreciable differences in Ledebur oxygen between "deoxidized" steels; and, even so, the amount of Ledebur oxygen in treated steel should bear no particular relationship to the blowholes present. It is well known, for example, that casting steel or forging steel must be treated with a "degasifier," such as silicon or aluminum, in addition to the "deoxidizer," manganese. The manganese is certainly capable of reducing ferrous oxide but it does not eliminate blowholes. On the other hand, both Oberhoffer and Schmitz<sup>1</sup> in their recent work with this method show a drop in the "Ledebur oxygen" with deoxidation by ferromanganese. If this is substantiated by work at the Bureau, it may prove to be possible to check analytically the efficiency of the manganese addition and the degree of oxidation subsequent to this addition.

On p. 1321, it is proposed to use, as a criterion of the suitability of an alloy for deoxidation purposes, the fusibility and viscosity of the slag formed during such use, and to test this by experiments on various oxides. There are several important objections to the use of this test. The alloys used in the oxidation process, and for which the alloys in question are actually used, are generally assumed: (1) to react with oxides in the steel and form, as reaction products, oxides of the constituents of the alloy added, and (2) to act in some way, as yet not understood, to inhibit the evolution of hydrogen and nitrogen. Evidently only the first reaction is considered, and the efficiency of the addition in the second reaction would be missed by the test. Certain alloys are used principally on account of their efficiency in the second reaction and would be entirely too costly to use for the first, for which manganese seems to be eminently suited.

The assumption is made, tacitly, that the constituents of the addition oxidize in the same ratio as they occur in the alloy, and that the oxidation products unite. This assumption seems quite logical but its validity will not be assured until the reaction products are identified. In our work on manganese we felt that a big advantage in using manganese-silicon alloys would be obtained because a silicate slag would form, but we could not advance that as a positive advantage because identification of the reaction product was lacking. So important did it seem to identify reaction products that the writer has gone into the matter through a grant from the Carnegie Scholarship Fund (Iron and Steel Institute).

There is the possibility that a certain amount of iron oxide is simply dissolved in the reaction product. This action would depend considerably on the concentration of the reducing agent. This may or may not be a minor point but it should be considered when determining the criterion

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<sup>1</sup> *Stahl u. Eisen* (1918).

to use for deoxidizers. It must also be borne in mind that the reaction products form during deoxidation in the presence of a large excess of iron, while synthetic slags form under different conditions. Again the necessity of identifying reaction products is evident.

The gases present in steel are classified into three groups (p. 1314). The classification as advanced involves considerations of the homogeneous equilibrium of the steel because it would be difficult to distinguish between gases that are in solution as such, and as compounds. It might be advisable, for the present, to place gases in solution and gaseous compounds in solution in the second group.

### Mechanical Separation of Sulfur Minerals from Coal

Discussion of the paper of J. R. CAMPBELL, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1779.

G. R. DELAMATER,\* Steelton, Pa. (written discussion†).—Under the heading, "Preparation of Coal," Mr. Campbell discusses the advisability of sizing the coal for the jigs. While I fully realize that conditions alter cases, my method at all times is to do everything possible to avoid sizing. It would be unwise for anyone to say that greater ash and sulfur reduction is impossible by sizing. The thing that can be questioned is, will the greater reduction be sufficient to counterbalance the greater cost? The same thing is true of the proper size of crushing for each individual proposition.

In past years many washeries have been built and equipped for washing two or more sizes, but I know of few instances where these plants were operated more than a year before sizing was abandoned. Perhaps in some of these cases this was due to lack of sufficient development of such scheme of operation; yet I have found that most men engaged in this work, including myself, started into the work with a pretty well-fixed idea that sizing would be beneficial. But trials and tests showed that the mixed size washing is necessary for coals requiring crushing to 1 in. or less.

Coal is of low value, compared with other minerals segregated by washing or concentration, for which reason simplicity must be the watchword: simplicity in the machine used to attain the separations of impurities from the coal, in the accessory plant equipment, and in its arrangement.

Mr. Campbell mentions the quite recent introduction of concentration tables in the washing of coal. It must be admitted that good results

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\* Coke Oven Dept., Bethlehem Steel Co. † Received Oct. 28, 1919.

in many cases have been obtained, in so far as ash and sulfur reduction are concerned, yet tables also are open to some very serious objections.

The greatest troublemaker to the washery operator is fine coal. It is largely responsible for excessive coal losses. It clogs the water-pipe lines and the jig hutchers; and if care is not taken in pump-sump design, the building up of fines and the sudden release to the pumps causes many hours of work and expensive delay. This, therefore, makes important the advisability of careful investigation to determine whether any appreciable ash and sulfur reduction can be attained in the washing of the fines or whether the fines carry any considerable quantity of the impurities. In many cases they do; in many others they do not. Recent developments in screening apparatus have made it possible to screen where screening has been impossible before; this is a feature to which the writer is giving much study at the present time.

Mr. Campbell's reference to single or multiple-compartment jigs is of much interest as this is another feature in which experience has entirely altered my views. At first, it seemed that the more compartments there were the more rewashing the coal received and the better the results must be. While there are certain conditions under which two or more compartments can, and possibly should, be used, several years of careful experimenting have led me to believe that these conditions seldom, if ever, exist in coal washing. The water flow and pulsation strength are governed by the size and nature of the material treated. Coal containing considerable refuse material of high specific gravity requires greater water flow and pulsation than coal containing only refuse material of a medium specific gravity. In the multiple-compartment jig, the heaviest refuse is admittedly removed in the first compartment, so the second compartment should have a smaller water flow and strength of pulsation. While the outside water feed to the second compartment may be less than to the first, and the pulsation is easily made suitable, it is impossible to avoid the water that flows from the first to the second compartment with the washed coal. This but multiplies with each added compartment until the cross flow seriously affects the proper action on the bed by the pulsation and undesirable disturbances of the bed result. If dewatering were effected between each compartment, this would be avoided. My experience has been that the main claim for multiple-compartment jigs is capacity per jig, but this does not mean per square foot of screen surface, and that three single-cell jigs with a total screen area equal to that of a three-cell jig will treat an equal tonnage at higher efficiency on account of better control of water flow and pulsation strength and because it is necessary to send only one-third the tonnage of coal over any given square foot of the total screen area employed.

The value of a jig over a table is the ability to maintain the mixed area of the bed practically stationary between the two points of removal

of washed coal and refuse. Water disturbances that break up this "dead line" ruin the effectiveness of the jig.

Mr. Campbell's statement that any jig that will not produce only two clean products—washed coal and refuse—is inefficient, is possibly misleading. I agree that a jig should be capable of such performance but there are good coking coals that are separable into three products: first, the greater percentage suitable for coking; second, a small percentage acceptable only as refuse; and, third, a fair percentage that is neither good enough for coking nor poor enough to throw away as refuse. First washing should segregate only the coking coal and the refuse should be rewashed to segregate the middlings. While attempts have been made with jigs to produce three products in operation, I have always found them inefficient.

I have experimented for over 5 years with centrifugal driers and must admit that they alone will not successfully dry fine coal when designed for continuous operation. While great claims are made for special systems of draining bins and pits, one has only to visit washeries so equipped, and by observation of the auxiliary equipment added and by questioning the operator of the plant, to learn that these have failed to satisfactorily solve this problem. With this feature still unsolved, the concentration table has very serious drawbacks as a machine to be used, except if found necessary to wash the fine coal separately. The fact should be borne in mind, in the study of these questions, that coal washing is each day becoming more closely allied with the byproduct coke plant and high moisture cannot be countenanced in the coal to such ovens. We must forget the loop-holes the beehive oven let us crawl through in the past.

I have never doubted the ability of Dorr thickeners to clarify the water but have seriously doubted the finding of a successful way to handle the underflow or sludge. To send it to the dewatering buckets or to the centrifugal driers was sure to result as the author states. To pump it directly onto the dried coal after the centrifugal driers has the great advantage, as stated by the author, of sure elimination from the washery system, yet the added moisture is a serious drawback, particularly where the washed coal is loaded on cars for shipment. This is another argument in favor of elimination of the fines, unless, as Mr. Campbell says, someone devises a successful dry concentrator.

Mr. Campbell's statement that "mathematical deductions are more accurate than the actual weights," etc. agrees with my experience. It should be added, however, that analyses should be based on large and frequent sampling. The plant of the future should be equipped with automatic samplers, not put in as an after thought but designed in with just as much careful attention as any other part of the equipment. Thousands of dollars are frequently spent on laboratories and chemists to work on samples that are not representative.

### High-temperature Control

Discussion of the paper of C. O. FAIRCHILD and P. D. FOOTE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1701.

R. W. NEWCOMB, New York, N. Y. (written discussion\*).—On page 1712, the middle paragraph states that, in industrial equipment, only the single-step method of automatic regulation has been applied. Quite recently, there has been developed an automatic temperature regulator, operating in conjunction with a pyrometer of the thermoelectric type, in which the control is a slow regulation, with a range capable of regulating valves, dampers, rheostats, or any other rotatable member, through one or more complete revolutions. It can control two valves at the same time, with a fixed definite ratio between them.

Aside from those conditions in which it is necessary to control two valves with a definite ratio one to the other, the greatest advantage that this slow, even control will have over those controls that are either all on or all off, will be for use in connection with processes where a large temperature variation is required, extended over a considerable period of time; that is, where the temperature must be regulated along an increasing or decreasing time-temperature curve.

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### Thermoelectric Pyrometry

Discussion of the paper of P. D. FOOTE, T. R. HARRISON and C. O. FAIRCHILD, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2631.

J. T. LITTLETON, JR.,† Corning, N. Y. (written discussion‡).—This discussion will add little that has not been brought out but will show how the problems encountered in the Corning Glass Works were overcome. The chief points of consideration in any equipment are, first, the work the equipment is called upon to do; second, the installation; and, third, the man who will use it. These three points should determine the type of apparatus adopted. If only rough measurements, merely a little better than the eye, are desired, the cost of the instruments should be considered; but if accurate temperature control is necessary, the cost of the equipment deserves only small consideration. There is no question that the real problem for any factory is the installation, making sure that the elements really give the temperatures desired; also, the instruments must be so designed that any man can use them.

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\* Received Oct. 15, 1919.

† Physical Laboratory, Corning Glass Works.

‡ Received Oct. 8, 1919.

Platinum-rhodium thermocouples are necessary for all glass-melting operations. As the change in calibration of these elements is a very serious factor, each element should be tested for change at least twice a week when used for continuous high-temperature service. The new couples should also be calibrated, as couples differing from the standard by  $10^{\circ}\text{C.}$  at  $1200^{\circ}\text{C.}$  are often met with. For the majority of commercial work it is not necessary to know the actual temperature of the substances treated but it is necessary to control this temperature. Experience will show that a certain temperature reading on a given installation gives the desired results.

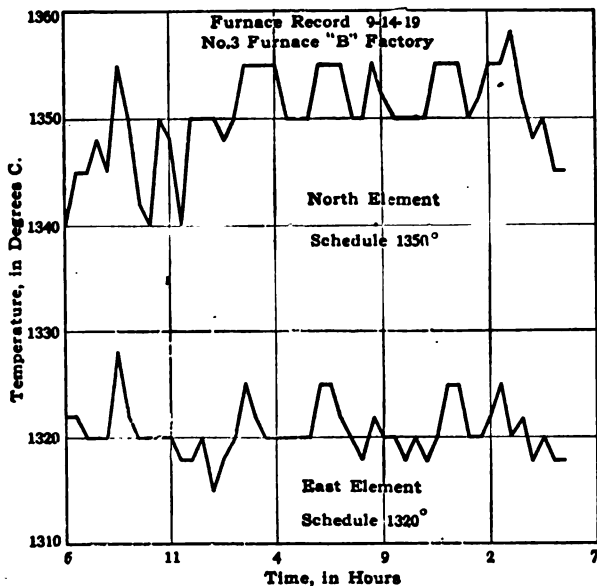


FIG. 1.

The authors of the paper set plus or minus  $10^{\circ}\text{C.}$  as a practical limit of accuracy; this variation is too great. Glasses at the standard melting temperature vary in viscosity about 20 per cent. for such a temperature change. The relaxation time in annealing will vary by a factor of 4 for such a range. Besides, greater accuracy of control can be obtained. The curves shown prove this point. They are from a regular factory chart for a 24-hr. run on a large glass pot furnace and record that a plus or minus  $5^{\circ}$  variation is not too much to demand or set as a standard. Accordingly if an instrument or couple should fail, previous conditions should be reproducible to within that degree of accuracy at least. That demands a standard testing equipment.

Test standardizing equipment at the Corning Glass Works consists of a primary, a secondary, and a factory standard thermocouple. The

primary standard is a Bureau of Standards couple that is checked against the secondary standard about twice a year and against the melting point of standard metals furnished by the Bureau of Standards. The secondary standard is checked at the gold point whenever thought desirable. The factory standard element is checked against the secondary standard at regular intervals by means of a Leeds & Northrup precision potentiometer with a Bureau certified standard cell. The difference between the couples is read directly by connecting them in opposition. A nichrome-wound furnace is used as a standardizing furnace and corrections above the limit of this furnace are obtained by extrapolation. Each factory couple is mounted in a double-bore hard-clay tube and twice a week the factory standard is placed in the hole beside the couple under test and the correction obtained. Records are kept of these corrections and the actual temperature of the element tube may be known at any time to within about  $3^{\circ}\text{C}$ . The schedule is modified to meet all calibration changes. This merely amounts to using a slightly different temperature unit. It would be very unfair to many manufacturers to give the results obtained with particular instruments, as what will best suit one set of conditions will not suit another.

An instrument that requires two settings before taking a temperature reading is not suitable for some operations. If the temperature is changing rapidly the instrument lag may be sufficient to cause trouble. Also, when the instrument is in the hands of an unskilled operator, as is nearly always the case, the chances of error are increased. If many temperatures are taken, the time involved may be a factor. Line-resistance and cold-junction changes should be given all the consideration possible. Water-cooled cold junctions are used on all platinum-rhodium elements. About 170,000 gal. of water a year are used on each couple. This costs about \$6 a year, including overhead and installation depreciation; the installation cost is about \$25 per couple.

Line resistance, due to faulty connections and deteriorated base-metal couples, has at times caused a difference as great as  $200^{\circ}\text{C}$ . By using a 500-ohm resistance deflection-type suspension millivoltmeter, together with a potentiometer recorder, all such changes are instantly picked up due to failure of the two instruments to check. Serious damage might have been incurred had the furnace had to wait until the line resistance could be checked before the change was discovered.

On base-metal couples, a partial-deflection potentiometer is used; this will indicate a high resistance when the partial-deflection readings do not check the balanced settings. The ordinary operator will not notice a change in sensitivity of the potentiometer.

The chief point of advantage of the dual system is that it gives the desirable features of both types of instruments without the disadvantage of a second setting common to the types which combine the two in one

instrument. It may be said that trouble has been experienced in getting operators to control by a recorder.

The general installation is the real factory problem. With the proper installation most of the high-grade instruments will give good service. The location of the couple, so that it gives a control temperature similar to the substance treated, is extremely important. With the proper central-station control, it is easily possible to overemphasize the robustness of the instrument. One advantage of the deflection type is that it may be mounted in a dust-proof box and need never be touched. The average operator will not write on his record false readings but if he can, so to speak, fool the instrument by throwing two couples in parallel or by any other means smooth out his record, he might do so. Any opportunity for him to get at the wiring should be avoided.

Switches are sources of continuous annoyance. The protection tubes used are all manufactured in the ceramic laboratory of the Corning Glass Works and are satisfactory, though improvements are always desirable. The Corning Glass Works has had thermoelectric equipment for about 15 years and the present system is the result of much experimentation and work. Satisfactory results are obtained but there are problems still ahead.

EWART S. TAYLORSON,\* Pittsburgh, Pa. (written discussion†).—The writers of this paper are to be congratulated on being the first to publish a comprehensive collection of thermocouple wiring diagrams; but it is well to point out the difference between the zone-box and cold-

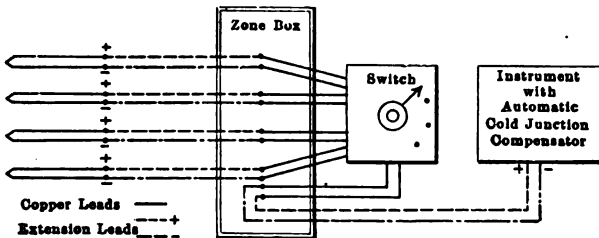


FIG. 1.

junction-box systems. A zone box, as its name implies, is a zone of uniform temperature which, however, need not remain constant. In the cold-junction box the temperature must either remain constant or allowance must be made for its variations. In thermoelectric work, the zone box is used to eliminate the thermoelectric effect of similar junctions connected in opposition in the same circuit by keeping them at the same temperature; their resultant voltage is thus negligible. This principle has been successfully applied for many years in the design of electrical resistances, especially those of low values constructed of constantan.

\* Research Laboratory, American Sheet & Tin Plate Co. † Received Oct. 17, 1919.

The junctions with the copper circuit are brought into close proximity to secure uniformity of temperature and avoid thermoelectric errors. It should be definitely understood, however, that this zone-box principle is not limited to only two opposed junctions; it can be applied to any number of opposed junctions, as shown in Figs. 32, 33 and 34, in which all the junction boxes are in principle zone boxes. Whether these opposed junctions are brought into the zone box as extension leads, as in Fig. 32, or as auxiliary couples, as shown partly in Fig. 33, depends entirely on such factors as economy of material and convenience in wiring. If these points are kept in mind, the criticism of the zone-box system on p. 2680 is certainly not justified, as no complicated interlacing circuit is ever necessary and the switch can be placed at any desired position by the use of ordinary copper wire. The copper circuit to the switch and instrument can be of any suitable design as long as it is homogeneous and finally reenters the zone box.

The auxiliary couple shown in Fig. 33 is said to bring the cold junction to the recorder, whereas the diagram shows two junctions, one at the switch and one at the recorder. This, however, can be easily corrected by extending both wires of this couple to the recorder and connecting the free wire to the switch by a copper lead.

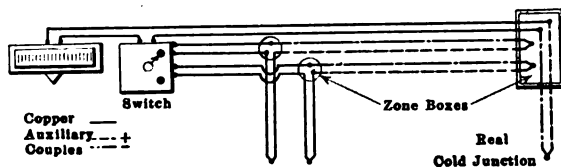


FIG. 2.

For the sake of completeness, other useful applications of this principle are shown in the diagrams here shown. The first system, Fig. 1, is used with an instrument having an automatic cold-junction compensator, such as some of the Leeds & Northrup potentiometers or the instrument with bimetallic zero control developed by C. R. Darling and recently revived by Bristol. This method is sometimes more convenient than that shown in Fig. 33, though theoretically they fulfill the same purpose. Fig. 2 shows a zone-box system that uses only auxiliary couples, thus avoiding the controversy over patents that was in progress at the time this method was developed.

PAUL D. FOOTE, T. R. HARRISON, AND C. O. FAIRCHILD.—Mr. Taylerson arbitrarily defines the "zone box" as equivalent to the junction box already described by us whereas actually the "zone box" is designed for use with a single couple. This is illustrated by Fig. 34 taken from the Wilson-Maeulen catalog. Accordingly his Fig. 1 is the same as our Fig. 33, describing the use of a junction box, except that he employs an addi-

tional and unnecessary pair of copper leads between the junction box and the switch and recorder, which are usually located close together and hence are at the same temperature. If for any reason the switch and recorder are at different temperatures, Mr. Taylerson's method of using the junction box will be correct for such a difference, but a simpler method is to use the wiring diagram of Fig. 33, except that a positive compensating lead is substituted for the copper lead from the switch to recorder.

In his Fig. 2, a combination of the zone box and junction box is employed. In general the use of the zone box in such an installation complicates matters and requires additional wiring. However it may be of advantage under the following rare condition. If some of the couples in Fig. 33 or 34 are so situated, geometrically, that they lie between the junction box and switch, a zone box may be used at each of these couples, copper leads from the switch to the zone boxes, and compensating leads or auxiliary couple from the zone boxes to the junction box, the method of connection through the zone box being that illustrated by Fig. 34 except that the auxiliary couple terminates in the junction box instead of the ground. This system saves lengths of copper leads from these couples to the junction box.

W. P. WHITE,\* Washington, D. C. (written discussion†).—From the description, convenient working of the Harrison-Foote compensated indicator involves increasing the circuit resistance to ten or more times that of the thermocouple. This is no disadvantage if a relatively high resistance galvanometer has already been decided upon. The instruments depending on the potentiometer principle do not suffer to the same extent, as Williamson and Roberts have pointed out in their paper on thermocouple installation in annealing kilns. I have found that, in some cases, where one type of reading instrument was said to be superior to another, the real difference lay in the quality of the instrument and not in the principle at all. I must disclaim all credit for the deflection potentiometer shown on p. 2651. The split circuit here is employed in a different way from that which I had proposed, and with a different purpose.

It seems possible that the 2° variation of temperature of a point 10 ft. underground, determined in England, may be less than it would usually be in the more variable climate in most parts of this country. This statement is merely to correct a possible misapprehension. If readings of the temperature are taken from month to month, the constancy seems likely to exceed all ordinary requirements.

Nichrome wires and other alloys containing nickel can frequently be wound in fairly close coils without any other insulation than the layer of tarnish which they ordinarily possess. It seems that this fact might sometimes be useful in thermocouple construction, although the trouble

\* Physicist, Geophysical Laboratory.

† Received Sept. 25, 1919.

and expense of porcelain insulation would usually be preferable to taking any chances. I have found that a furnace wound with No. 32 nichrome wire worked well without any special insulation, and the efficiency of the oxide layer would be enormously greater with the very large wires used for commercial base-metal couples. Apparently it would not do to trust the oxide layer in a reducing atmosphere.

The methods and apparatus here described, although intended for pyrometry, are likely to be applied to work of higher precision. It therefore seems in order to call attention to an error which may come in such work regarding the cold junction where this is different from the room temperature, as it may often be, especially where ice is used. Since copper is a very much better conductor of heat than most of the metals used for thermocouples, its conductivity may, if precautions are not taken, falsify the cold-junction temperature. Even wire as small as No. 18 has been known to do this to a marked degree.

T. R. HARRISON (written discussion\*).—Regarding the objection that the Harrison-Foote instrument requires the use of high resistance in series with the galvanometer, thus reducing the sensitivity of a given instrument, as actually manufactured, this instrument makes use of resistances (sometimes called swamping resistances) placed in series with the moving element for the accomplishment of desirable purposes, other than that referred to (such as reducing temperature coefficient and eliminating the necessity of making too frequent readjustment of the rheostat to compensate for minor changes of resistance). This relatively high resistance has been made possible for thermocouple work through the development of galvanometers of relatively high sensitivity. Through this feature, a construction of the compensating instrument is possible whereby accurate adjustment may be obtained with little care. The principle may be applied, however, by using a much lower swamping resistance than is usually employed; this involves a more careful adjustment of the rheostat in order to realize e.m.f. readings of a given accuracy.

If a swamping resistance value equal to the maximum resistance of couples to be used with the instrument is adopted, adjustment must be made with a precision equal to that required in the final e.m.f. reading. Further reduction of the swamping resistance nets no gain in precision of e.m.f. observations, as the increased sensitivity is offset by the necessity of proportionately increased accuracy of adjustment. Thus, any galvanometer provided with swamping resistance as great as the maximum allowable resistance of the couple can be converted into a Harrison-Foote compensated instrument without the addition of any resistance whatever to the circuit. Evidently the possible sensitivity increases as the maximum allowable couple resistance is reduced.

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\* Received Oct. 27, 1919.

### Some Factors that Affect the Washability of a Coal

Discussion of the paper of THOMAS FRASER and H. F. YANCEY, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1817.

CARL A. WENDELL, New York, N. Y. (written discussion\*).—I have never seen in print anything that even remotely has approached this article in clearness and important conclusions in conjunction with work done on the sink-and-float test. I have had many hundreds of these tests made and on different specific gravity solutions and the resultant product analyzed, but I have never grasped nor been able to show what this article sets forth. This article brings out one factor very clearly to my mind; what is to take the place of the solutions of different specific gravities used to obtain the laboratory results, when it comes to washing on a large scale, since water has one constant weight only? The answer is, sizing of coal. And as we know the importance of size versus specific gravity of the material to be washed, perhaps defined (practical) lines can ultimately be gotten up so that the sizing, if any, may be determined at the same time as the laboratory work on the coal is being done.

G. R. DELAMATER,† Steelton, Pa. (written discussion‡).—The authors' deductions are well founded and although they disclaim any wide experience in commercial coal washing, practically all of the data presented are applicable to coals of all parts of this country. The paper clearly sets forth the great necessity of careful preliminary investigation of each contemplated washery undertaking and contains the following very true statements. "It is not safe to assume that any coal which can be successfully washed on coarse coal jigs can be cleaned more completely by washing at a finer size on tables," and "The effect of finer crushing upon the completeness with which impurities may be separated from coal depends upon two opposing tendencies. First, that the more finely a raw coal is crushed, the more completely will the particles of impurities be detached from the particles of clean coal. Second, the finer a coal is crushed the more difficult it becomes to separate the pieces of clean refuse from the pieces of clean coal."

The use of tables is quite new in coal washing; but because they may be successful in some instances is no proof that they will be in all. Their

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\* Received Oct. 8, 1919.

† Coke Oven Dept., Bethlehem Steel Co. ‡ Received Oct. 28, 1919.

use should be governed by their adaptability to the various conditions found in any washing proposition. As we near the day when every coal washery proposition will be carefully studied before the plant is designed, coal washing will lose the stigma it has carried so long and its cost will reach a level that will overcome much of the prejudice now existing against it. With the hit-and-miss method of the past, too many plants have failed as first built, because of the necessity of extensive alterations. Had a thorough study been made at first, the plant would have produced with greater efficiency and lower operating cost than is possible with the made-over plant; and in many instances first cost would have been reduced.

The prospective washery owner should not be satisfied with a stereotyped washery layout but should be prepared to spend the necessary money to obtain the following information about his coal:

1. A careful study of conditions within the mine, to be sure that unnecessary expense is not placed against the washery by improper mining practices. Included in this would be an effort to determine the advisability of including such parts of the seam as have not been mined on account of quality. Coal-washing costs may frequently be higher than at other washeries, with reason, if such increased cost results in greater return per acre of that particular coal land.

2. Thorough investigation to determine the proper crushing of the coal and the yield of washed coal that may be expected.

3. Screen tests to determine in what sizes the impurities are carried. This combined with float-and-sink tests and analyses and observation of the resulting products will assist greatly in the determination of:

4. Whether the coal can be cleaned by washing with any degree of success, advisability of sizing for washing, character of machines for washing, advisability of by-passing fines around the washery, suitability to drying by centrifugal driers or other systems, and probable water clarifying equipment necessary.

5. Proper plant arrangement to avoid excessive cost of up-keep and repairs, labor, power, and water consumption and features affecting coal losses and expensive operation delays.

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### Resistance Thermometry for Industrial Use

Discussion of the paper of CHARLES P. FREY, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1437.

G. A. ROUSH,\* South Bethlehem, Pa. (written discussion†).—Mr. Frey is correct in his impression that ice floats, but "frazil" ice happens to be the exception to the rule. The requirements for the formation of

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\* Assistant Professor of Metallurgy, Lehigh University. † Received Oct. 18, 1919.

frazil ice seem to be a clear, cold night and water on a bed of clean rock. The exact causes of its formation are not definitely known, but are supposed to be somewhat as follows. The rock bottom has a greater emissive power for radiant heat than the surface of the water, hence, on a clear, cold night, when conditions are most favorable for the loss of heat from the surface of the earth by radiation, the rock cools faster than the water over it, due to the greater radiating power of the rock and the partial transparency of the overlying water to the radiant heat. This may result in the formation of a film of ice of considerable thickness forming in contact with, and adhering to the rock, without the surface of the water having even reached the freezing point. When the sun strikes the spot the next morning, a reversal of the action takes place and the rock warms up faster than the overlying water, with result that the surface of the rock soon becomes warm enough to melt the film of ice in immediate contact with the rock, and the whole mass then floats to the surface.

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### Application of Pyrometry to the Manufacture of Gas-mask Carbon

Discussion of the paper of KIRTLAND MARSH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1611.

R. W. NEWCOMB, New York, N. Y. (written discussion\*).—This paper is particularly interesting to me, because it gives data on a much mooted question, viz., the serviceability of Le Chatelier (platinum-platinum-rhodium) thermocouples under severe industrial conditions. It has always been supposed that platinum-platinum-rhodium thermocouples, used at high temperatures under strong reducing conditions, would not give long service and were subject to rapid volatilization. The fact, however, that the carefully kept records indicate that a little more than 3 gm. out of more than 830 gm. was lost over this considerable period, shows what kind of service can be obtained from platinum-platinum-rhodium thermocouples, when properly installed, and well cared for.

While the writer has no actual figures on the loss of weight, etc. of platinum-platinum-rhodium thermocouples under service, he was told, by the man in charge of pyrometers at a large industrial plant in which over 400 platinum-platinum-rhodium thermocouples were installed in furnaces doing various kinds of heat-treating work, that the average maintenance cost, for materials alone, including platinum-platinum-rhodium wires and protecting tubes, was 27 c. per furnace, per month.

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\* Received Oct. 15, 1919.

CARLETON W. HUBBARD, Greenwich, Conn. (written discussion\*).—It has been my experience that there is a considerable difference in the serviceability and accuracy of platinum thermocouples. I believe it is said that this serviceability depends on several factors aside from the matter of the protection of the thermoelement wires. In view of the unusually good results described in the paper, from the use of thermocouples under conditions that can be considered as severe, it would be of value if the author could identify the manufacturer supplying the thermocouples he used while collecting his data.

### Heat Treatment of Duralumin

Discussion of the paper of P. D. MERICA, R. G. WALTEMBERG, and H. SCOTT, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 913.

ZAY JEFFRIES, Cleveland, Ohio (written discussion†).—The authors conclude that there is a certain average size of precipitated  $\text{CuAl}_2$  particle which produces maximum strength and hardness in duralumin; that when the size of particle is smaller or larger than this particular size the hardness decreases. The writer agrees with this conclusion, because it seems to be directly indicated by the facts.

Why does duralumin present this apparent discrepancy? Let us consider some physical aspects of the precipitation of  $\text{CuAl}_2$  from a saturated solution on cooling. When a molecule of  $\text{CuAl}_2$  is removed from the solvent, or matrix, and added to another group of  $\text{CuAl}_2$  molecules, as is known to occur on slow cooling, the forces of adhesion between the  $\text{CuAl}_2$  molecule and the solvent have been exceeded. Since a change in temperature only is sufficient to cause precipitation, it must also be sufficient to cause the loss of adhesion bonds between the excess  $\text{CuAl}_2$  molecules and the solvent, or matrix. Lost adhesion bonds means loss of cohesion of the mass as a whole.

When duralumin is cooled from  $500^\circ$  in a furnace, globules of  $\text{CuAl}_2$ , large enough to be seen easily with a high-power microscope, are formed. There are, however, globules so small as to be hardly distinguishable, and others too small to be resolved are suggested by the non-uniformity of the surface appearance of the section. As the smallest globule of  $\text{CuAl}_2$  resolvable with a high-power microscope contains about 2,000,000 molecules, it is evident that with rapid cooling submicroscopic particles of  $\text{CuAl}_2$  must be present in large numbers; in fact, after quench-

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\* Received Oct. 29, 1919.

† Received Oct. 21, 1919.

ing, the average size of particle must be submicroscopic. The whole phenomenon of aging must therefore involve changes that cannot be studied directly with a microscope.

We must also accept the proposition that the change in properties on aging are due to molecular changes within the metal; that those molecular arrangements are not possible in liquid air; that they take place slowly at ordinary temperature and more rapidly as the temperature is increased. We can visualize these molecular rearrangements best by assuming that the precipitation of  $\text{CuAl}_2$ , and segregation into particles, are two distinct steps. Immediately after quenching duralumin from  $500^\circ$ , the excess  $\text{CuAl}_2$  is considered to be precipitated; some of it will have formed into small particles, and some will be precipitated as single molecules which have little or no adhesion with the particles of the matrix. This condition produces the low mechanical cohesion observed in duralumin after quenching and before aging. The increase in cohesion of the whole mass could be brought about by the agglomeration of these precipitated molecules of  $\text{CuAl}_2$ . In the first place, the particles of the matrix would establish cohesion bonds with one another in the space formerly occupied by a  $\text{CuAl}_2$  molecule. This would increase the cohesion of the matrix, then the small globule, made up of many  $\text{CuAl}_2$  molecules, would acquire its own specific cohesion.

Having thus produced increased cohesion of the matrix and the  $\text{CuAl}_2$  particles, we have only to account for the observed increased cohesion or hardness of aged duralumin.

As some  $\text{CuAl}_2$  is soluble in the matrix at room temperature, it is only the excess that can form into minute globules. The presence of a globule of  $\text{CuAl}_2$  acts as a center of crystallization, and hence easily attracts to itself the adjacent excess  $\text{CuAl}_2$  molecules in the matrix and impoverishes the matrix at the boundary. This accomplishes two things; it facilitates migration of  $\text{CuAl}_2$  toward the globule by forces of diffusion and it reduces the number of  $\text{CuAl}_2$  molecules in the matrix at the boundary with the globule to normal saturation, which is the condition for maximum adhesion between  $\text{CuAl}_2$  and the matrix. Thus the strong adhesion bond between these two substances is established. It is probable that the concentration of a saturated solution of  $\text{CuAl}_2$  in aluminum in the absence of  $\text{CuAl}_2$  nuclei is greater than when these nuclei are present. It is also probable that the actual boundary between a  $\text{CuAl}_2$  particle and the matrix is an amorphous solution of  $\text{CuAl}_2$  in aluminum.

According to the above, the reason that maximum diffusion does not produce maximum cohesion is that the adhesion bonds between the excess  $\text{CuAl}_2$  molecules and the matrix are not strong, and the spaces they occupy might act as voids in affecting cohesion. Aging removes the voids from the matrix, thus increasing its cohesion; it establishes cohesion in the

newly formed  $\text{CuAl}_2$  globules, and adhesion between these and the matrix. If the particles of  $\text{CuAl}_2$  continue to increase in size beyond a certain average, and decrease in number, as in prolonged aging, at  $200^\circ$ , the cohesion decreases.

The formation of cohesion and adhesion bonds between the atoms and molecules in duralumin at room temperatures might be questioned. If we press two pieces together and allow them to remain at ordinary temperatures for long periods of time, we cannot produce such results. No doubt the absorption phenomenon militates against this low temperature welding,<sup>1</sup> as do unclean surfaces due to oxidation. The formation of cohesive masses of metal at ordinary temperature by electro-deposition teaches us that high temperature is not necessary for the formation of cohesive bonds. The interior of a mass of duralumin should be free from adsorption and oxidation, hence the atoms and molecules would be free to form bonds with one another at temperatures much below that of welding. It should be kept in mind that welding is accomplished at high temperatures in spite of the retarding influences of adsorption and oxidation.

The heat evolution observed at about  $260^\circ$  might well be due to a rapid crystallization of  $\text{CuAl}_2$  rather than the mere precipitation. The fact that rupture takes place through the grains is evidence that, whatever changes go on within the alloy, those that affect the physical properties must be intracrystalline.

Other alloys will, no doubt, show similar changes in properties when studied in the proper temperature range. Future investigations of alloys at various temperatures must form the basis for a more complete and modified interpretation of the new and old facts observed in connection with the phenomenon called aging. Quantitative evidence must be introduced as soon as facts permit. Aging experiments on duralumin extending over a period of many years will be interesting with respect to the relations between the changes in properties and the engineering uses. It is obvious that the material cannot be used at  $200^\circ$  for a long time without changing markedly in properties. What is the maximum temperature that will permit so little change on extended aging of duralumin that it may be used with safety at that temperature? A study of this question is necessary in order to change the specific composition and heat treatment of the alloy to meet certain engineering requirements.

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<sup>1</sup> Langmuir: *Jnl.*, Amer. Chem. Soc. (1916) **38**, 2221; (1917) **39**, 1848; (1919) **41**, 868.

## Deterioration of Nickel Spark-plug Terminals in Service

Discussion of the paper of HENRY S. RAWDON and A. I. KRYNITZKY, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1323.

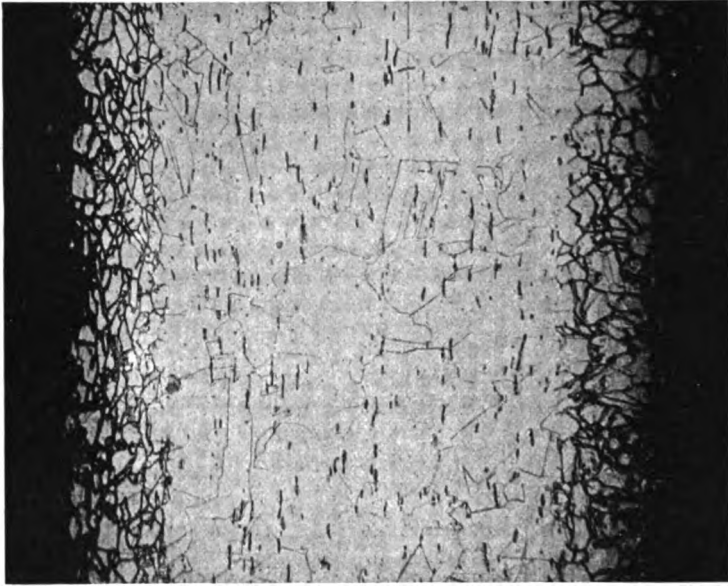
PAUL D. MERICA, Bayonne, N. J. (written discussion\*).—The mode of intercrystalline oxidation which the authors have so well observed and described is characteristic of nickel that has been exposed to the action of an oxidizing atmosphere at higher temperatures, such as those at which it is annealed or heated for rolling or forging. Oxidation under such conditions proceeds inward from the surface along the crystal boundaries producing a net-work, probably of oxide, which causes a very brittle condition of this surface material. This, in turn, generally results in surface cracking and checking during further rolling and a defective sheet or other product is produced.

An example of this is shown in Fig. 2, which shows the surface of a badly surface-cracked sheet of nickel produced by incorrect heating conditions. A cross-section of this sheet etched with nitric acid is shown in Fig. 1, which reveals the intercrystalline oxidation network adjacent to both surfaces. These layers are so brittle that it is not possible to deform them by rolling without severe cracking along these lines or planes of weakness. The best, and possibly only, remedy for this condition lies in its prevention by the maintenance of a neutral soft flame for heating and annealing nickel during the entire course of its manufacture.

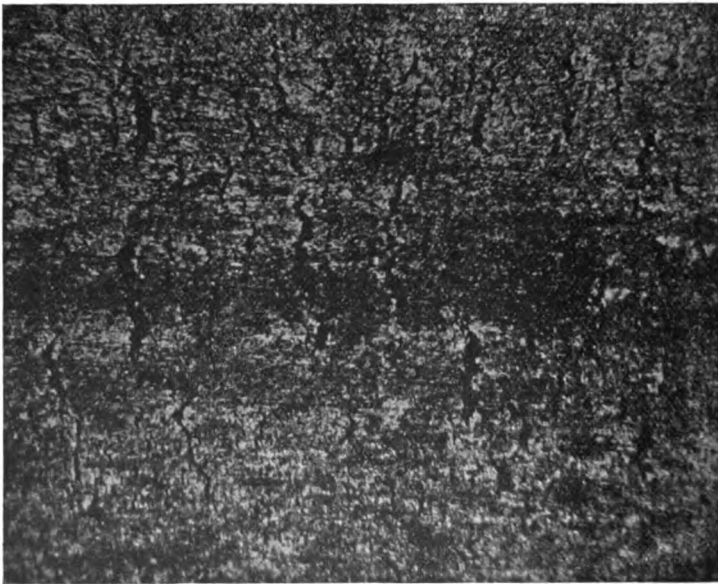
I should like to suggest that those making microscopic investigations of nickel and nickel-rich alloys try the use of acetic-acid solutions of nitric acid for etching these metals rather than aqueous solutions of nitric acid. I have found that a solution containing 50 per cent. nitric acid, from 25–45 per cent. acetic acid, and from 25–5 per cent. water gives excellent results with wrought and cast nickel and Monel metal and superior results to those obtained with nitric acid alone. The acetic acid seems to inhibit the passivity that nickel often assumes toward nitric acid and much more uniform etching may be obtained. The proportions of nitric and acetic acid may be varied somewhat from those given without materially altering the quality of the etching, although without any distinct improvement in it.

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\* Received Sept. 29, 1919.



**FIG. 1.—CROSS-SECTION OF NICKEL SHEET ETCHED WITH NITRIC ACID (50 PER CENT. IN 50 PER CENT. ACETIC ACID) SHOWING INTERCRYSTALLINE OXIDATION OF SURFACE LAYERS.  $\times 100$ .**



**FIG. 2.—UNETCHED SURFACE OF SAME NICKEL SHEET SHOWING SURFACE CRACKING AND CHECKING DUE TO OXIDATION.  $\times 100$ .**

## Effect of Time and Low Temperature on Physical Properties of Medium-carbon Steel

Discussion of the paper of G. A. REINHARDT and H. L. CUTLER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1091.

WALTER N. CRAFTS,\* Toronto, Canada (written discussion†).—During the forging of 9.2-in. shells for the United States Army, it was noticed that better results were obtained in certain instances when test bars had been held some time before pulling. An investigation, therefore, was made by our metallographer, Mr. F. M. Arnold, to determine the effect of seasoning.

The forging consists of a single operation, piercing a solid cast blank. The test sections were cut from the walls by an oxyacetylene flame, one piece from the nose end and one from the base on the opposite side. The test pieces were not heat treated in any way and the tests and seasonings were carried on at normal atmospheric temperatures. The specifications were as follows: Standard 2-in. test bar, 0.505 in. in diameter; elastic limit, over 19 long tons, or 42,500 lb.; ultimate stress, 39.6 to 49.1 long tons, or 87,500 to 110,000 lb. per sq. in.; elongation, over 13 per cent.

As a preliminary test two heats were selected; BP555, which was tested and reported failed on elongation on Aug. 20; and BO1771, which was tested and reported failed on Aug. 24. On Aug. 29, retests were cut and machined from the same shells and held till Sept. 3 (5 days) when they were pulled. Both sets of results are given below.

|   | Elastic Limit,<br>Lb. Per<br>Sq. In. | Ultimate Stress,<br>Lb. per<br>Sq. In. | Elongation,<br>Per Cent. | Reduction<br>in Area,<br>Per Cent. |
|---|--------------------------------------|--|--------------------------|------------------------------------|
| <i>Heat BP555, carbon, 0.54 per cent.; manganese, 0.66 per cent.</i>  |                                      |  |                          |                                    |
| Original bar 1, machined and pulled at once . .                       | 52,410                               | 104,200                                | 10.0                     | 16.0                               |
| Original bar 2, machined and pulled at once . .                       | 51,510                               | 104,200                                | 9.5                      | 12.5                               |
| Retest bar 1, held 5 days and pulled . . . . .                        | 53,070                               | 105,700                                | 14.0                     | 24.0                               |
| Retest bar 2, held 5 days and pulled . . . . .                        | 51,740                               | 106,400                                | 14.0                     | 24.0                               |
| <i>Heat BO1771, carbon, 0.55 per cent.; manganese, 0.70 per cent.</i> |                                      |  |                          |                                    |
| Original bar 1, machined and pulled at once . .                       | 52,640                               | 104,000                                | 9.0                      | 9.5                                |
| Original bar 2, machined and pulled at once . .                       | 51,290                               | 102,800                                | 9.0                      | 11.5                               |
| Retest bar 1, held 5 days and pulled . . . . .                        | 52,410                               | 105,700                                | 15.0                     | 23.5                               |
| Retest bar 2, held 5 days and pulled . . . . .                        | 53,910                               | 105,900                                | 15.0                     | 22.0                               |

\* Assistant General Superintendent, British Forgings, Ltd.

† Received Sept. 23, 1919.

This test showed a marked improvement especially in elongation. A further test was cut out of the last heat (BO1771) after it had lain 12 days after forging. The bars were machined and pulled immediately.

|                                   | ELASTIC LIMIT,<br>LB. PER SQ. IN. | ULTIMATE STRESS,<br>LB. PER SQ. IN. | ELONGATION,<br>PER CENT. |
|-----------------------------------|-----------------------------------|-------------------------------------|--------------------------|
| Bar 1, 12 days after forging..... | 52,000                            | 102,400                             | 9.5                      |
| Bar 2, 12 days after forging..... | 50,000                            | 102,000                             | 10.0                     |

These results, it will be seen, differ but slightly from the original test, for the conditions are similar throughout, except that the forging had lain dormant with opportunity to season, providing seasoning does occur in steel in the forged condition. They would indicate, therefore, that seasoning did not occur in this forging, at least in the walls of the shell.

It was thought strains might be left in the shell from the forging operation. Accordingly the nose was drilled out of the forging and 3 days later bars were turned up and pulled immediately with decidedly better results.

|            | ELASTIC LIMIT,<br>LB. PER SQ. IN. | ULTIMATE STRESS,<br>LB. PER SQ. IN. | ELONGATION,<br>PER CENT. |
|------------|-----------------------------------|-------------------------------------|--------------------------|
| Bar 1..... | 62,350                            | 105,900                             | 14.5                     |
| Bar 2..... | 61,900                            | 105,250                             | 12.5                     |

We then selected other heats in an effort to learn just where this change takes place—whether in the shell itself some days after forging, or in the test bars after machining. Assuming the first case, two heats were selected BP580, which failed that day, and BO1769, which had failed 10 days previously. Three blocks were cut from one shell of each heat, called A, B, and C, and were tested in the manner indicated with the results below:

|  | Elastic<br>Limit,<br>Lb. per<br>Sq. In. | Ultimate<br>Stress,<br>Lb. per<br>Sq. In. | Elongation,<br>Per Cent. | Reduction<br>in Area,<br>Per Cent. |
|--|---|---|--------------------------|------------------------------------|
| <i>Heat BP580, carbon, 0.52 per cent.; manganese, 0.74 per cent.</i>             |   |   |                          |                                    |
| Original test, Sept. 3.....  | 50,150                                  | 97,900                                    | 10.5                     | 15.5                               |
| Bar A, machined Sept. 4 and pulled immediately.....                              | 50,850                                  | 97,450                                    | 9.5                      | 15.0                               |
| Bar B, machined Sept. 4, held 5 days, pulled Sept. 9.....                        | 52,850                                  | 99,000                                    | 12.5                     | Not reported                       |
| Bar C, unturned block held 5 days, machined Sept. 9, and pulled immediately..... | 51,750                                  | 102,100                                   | 11.5                     | Not reported                       |
| <i>Heat BO1769, carbon, 0.53 per cent.; manganese, 0.75 per cent.</i>            |   |   |                          |                                    |
| Original test, Aug. 24.....  | 51,500                                  | 103,500                                   | 10.0                     | 13.0                               |
| Bar A, machined Sept. 4 and pulled immediately.....                              | 48,850                                  | 104,300                                   | 10.5                     | 13.5                               |
| Bar B, machined Sept. 4, held 5 days, and pulled Sept. 9.....                    | 55,100                                  | 104,800                                   | 15.5                     | 24.0                               |
| Bar C, unturned block held 5 days, machined Sept. 9, and pulled immediately..... | 55,350                                  | 105,100                                   | 14.0                     | 19.5                               |

The A bar of the second heat, even after 10 days rest in the forged condition, did not show improvement but in both cases the C bar, which had been cut out of the shell at the same time as the others, showed better results. This condition was similar to boring out the nose, for theoretically the strains in these bars were released upon being cut from the shell.

Assuming the second case as a possibility; namely, that seasoning may occur in the test bar after machining, from the last heat (BO1769) there were also cut and machined on Sept. 4 eight other bars, D, E, F, G, H, I, J, and K, which were pulled on succeeding days with fairly consistent results.

| Test Bar               | Elastic Limit,<br>Lb. per<br>Sq. In. | Ultimate Stress,<br>Lb. per<br>Sq. In. | Elongation,<br>Per Cent. | Reduction in<br>Area, Per Cent. |
|------------------------|--------------------------------------|--|--------------------------|---------------------------------|
| D pulled Sept. 6.....  | 51,050                               | 103,000                                | 13.5                     | Not reported                    |
| E pulled Sept. 7.....  | 53,750                               | 103,500                                | 15.0                     | Not reported                    |
| F pulled Sept. 9.....  | 50,000                               | 102,200                                | 14.0                     | 22.0                            |
| G pulled Sept. 10..... | 51,160                               | 102,600                                | 14.5                     | 20.0                            |
| H pulled Sept. 11..... | 52,600                               | 103,800                                | 16.0                     | 23.0                            |
| I pulled Sept. 12..... | 54,000                               | 104,850                                | 15.0                     | 22.5                            |
| J pulled Sept. 13..... | 51,600                               | 104,900                                | 16.0                     | 20.0                            |
| K pulled Oct. 4.....   | 50,000                               | 103,850                                | 17.0                     | 23.5                            |

| Heat   | Carbon,<br>Per Cent. | Manganese<br>Per Cent. | Test               | Elastic Limit,<br>Lb. per<br>Sq. In. | Ultimate Stress,<br>Lb. per<br>Sq. In. | Elongation,<br>Per Cent. | Reduction in<br>Area, Per Cent. |
|--------|----------------------|------------------------|--------------------|--------------------------------------|--|--------------------------|---------------------------------|
| BO1567 | 0.53                 | 0.64                   | Original test..... | 52,550                               | 102,350                                | 10.5                     | 13.0                            |
|        |                      |                        | Held 5 days.....   | 51,200                               | 102,450                                | 13.5                     | 18.5                            |
| BO1581 | 0.50                 | 0.71                   | Original test..... | 52,100                               | 102,200                                | 10.0                     | 10.5                            |
|        |                      |                        | Held 5 days.....   | 55,000                               | 105,000                                | 14.0                     | 21.6                            |
| BP577  | 0.59                 | 0.77                   | Original test..... | 51,400                               | 102,350                                | 12.0                     | 16.0                            |
|        |                      |                        | Held 5 days.....   | 52,000                               | 102,300                                | 14.5                     | 21.5                            |
| BP513  | 0.57                 | 0.73                   | Original test..... | 52,150                               | 99,500                                 | 9.5                      | 10.5                            |
|        |                      |                        | Held 5 days.....   | 53,400                               | 100,000                                | 15.0                     | 23.5                            |
| CD169  | 0.54                 | 0.65                   | Original test..... | 53,300                               | 97,300                                 | 7.5                      | 9.5                             |
|        |                      |                        | Held 5 days.....   | 48,850                               | 102,100                                | 14.0                     | 17.5                            |
| BP570  | 0.53                 | 0.70                   | Original test..... | 55,950                               | 109,650                                | 10.5                     | 14.5                            |
|        |                      |                        | Held 5 days.....   | 54,000                               | 106,600                                | 13.5                     | 20.9                            |
| BP575  | 0.57                 | 0.67                   | Original test..... | 53,150                               | 101,550                                | 9.5                      | 9.5                             |
|        |                      |                        | Held 5 days.....   | 52,400                               | 102,550                                | 11.0                     | 17.0                            |
| BP526  | 0.56                 | 0.76                   | Original test..... | 56,900                               | 107,859                                | 11.0                     | 16.5                            |
|        |                      |                        | Held 5 days.....   | 57,300                               | 109,250                                | 12.0                     | 20.5                            |
| BO3638 | 0.59                 | 0.79                   | Original test..... | 57,100                               | 113,400                                | 11.5                     | 17.5                            |
|        |                      |                        | Held 5 days.....   | 52,100                               | 100,400                                | 15.5                     | 22.0                            |
| BO1750 | 0.50                 | 0.79                   | Original test..... | 50,150                               | 98,550                                 | 9.5                      | 13.0                            |
|        |                      |                        | Held 5 days.....   | 47,800                               | 98,400                                 | 15.0                     | 29.0                            |

These results improved the longer the machined test pieces were held, though 5 days were quite ample for our needs.

Numerous other tests were pulled with such uniform results that it became our practice to hold the machined test bars 5 days whenever possible. The results of some comparative tests are given in an accompanying table.

Our experience indicated that almost without exception the process of seasoning the machined test pieces, while materially increasing the elongation and reduction in area, did not affect either the elastic limit or the ultimate stress to any considerable degree. Many of these bars were subjected to microscopic examination both before and after seasoning and pulling. With the equipment at our command we were unable to discern any change whatever in the microstructure of the steel. The signing of the armistice stopped all work so that we were unable to arrive at any conclusions or even theories.

E. GYBBON SPILSBURY, New York, N. Y. (written discussion\*).—In confirmation of Mr. Walter Crafts' remarks, it may be interesting to put on record an experience which I had some years ago at the Trenton Iron Works. We had been buying for some years a very special grade of low-carbon open-hearth steel from the Bethlehem Iron Co.; this steel was especially soft and had to be very uniform for the class of wire for which it was used. One shipment of billets, on being reheated and passed through the rolls, turned out so brittle that the rods made from it were absolutely useless. On our complaint, a very thorough investigation was made, by the Bethlehem Iron Co., of the heat from which this steel was made, and it was found that the charge of pig in the furnace was exactly the same as had been previously used—the same iron ore, the same limestone, and the same coke had been used in the furnace. One of the noteworthy features was that no amount of annealing seemed to soften the rods.

I started a very exhaustive series of analyses to try to discover the cause of the trouble. None of the chemists to whom samples were submitted detected any foreign ingredient in the steel until after a number of experiments Mr. Porter Shimer, of Easton, Pa., found a slight evolution of hydrogen. On investigation, the Bethlehem Co. found that the trouble coincided with the installation of the Archer gas producers in their plant and the use of the gas so produced in this special open-hearth furnace. Another heat was then made in the furnace, using the old form of producer gas, when the resulting material was perfectly satisfactory.

The first lot was so bad that the Bethlehem Iron Co. did not even care to have us send back the billets. About 4 yr. later, it was decided to

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\* Received Oct. 15, 1919.

use these billets to fill an order for very common rods. After some billets had been run through the mills, the foreman was surprised to find that these rods were as soft as any of the soft Bethlehem steel had ever been. A careful examination showed no trace whatever of hydrogen being left in the steel.

It is very evident therefore that this, while exceptional, is a clear example of the benefit of the aging of steel in enabling gases, such as hydrogen, to gradually escape at normal atmospheric temperatures. That the hydrogen can pass from one portion of the steel, under heated conditions, was well demonstrated by the fact that annealing of the rods drove the hydrogen to the center of the rod; which center then became as brittle as glass while the outside covering of the rod had somewhat softened.

### Oxygen in Cast Iron and its Application

Discussion of the paper of W. L. STORK, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 150, June, 1919, p. 951.

R. S. MACPHERRAN,\* Milwaukee, Wis. (written discussion†).—Mr. Stork's paper is very interesting, but I am unable to agree with some of his conclusions. He argues very strongly for the beneficial effect of oxygen, but gives no actual determinations of this element to support his views. He states that the oxygen resulting from a high bed, heavy charges, low coke ratio, etc. must not be confused with the oxygen under normal conditions. I will be glad to know in what respect these oxygens differ or in what state they occur. Is it his opinion that the beneficial type is present as a dissolved gas and the other as metallic oxide?

I will not discuss the first five of his six points, as I have not seen enough trustworthy determinations of oxygen in cast iron to form any conclusions as to its effect. I have never known the addition of manganese, however, to reduce the strength of cast iron.

Under the sixth point, I would say that the addition of steel lowers the total carbon content, and by this action will increase the strength independently of oxygen. This reduction of carbon operates also to raise the melting point. It is interesting to note here that the author, in order to get proper fluidity for his cylinders, was obliged to reduce his oxygen by raising the manganese in the charge.

J. E. Johnson, Jr., in his paper on the influence of oxygen in cast iron,<sup>1</sup> refers to the determination of sulfur in his "wild iron" and says that in these irons he found the volatile sulfur low in comparison with the total.

\* Chief Chemist, Allis-Chalmers Mfg. Co.

† Received Oct. 24, 1919.

<sup>1</sup> Influence on Quality of Cast Iron Exerted by Oxygen, Nitrogen and Some Other Elements. *Trans.* (1914) 50, 344.

It would be interesting to know whether Mr. Stork made any experiments along this line.

The determination of oxygen will undoubtedly give interesting data and assist in the better understanding of both steel and iron. This determination, however, is difficult, and requires a high degree of technical skill.

A recent bulletin of the Bureau of Standards,<sup>2</sup> brings out this fact and rather puts in question many of the determinations previously made by this method. To quote from page 32 of this paper: "The Ledebur method requires extraordinary precautions to obtain reliable results. The errors we have described undoubtedly affect in greater or less degree nearly all results by this method that have been described in the literature, and if these are approximately correct, it is because of compensating errors."

### Standard Scale of Temperature

Discussion of the paper of C. W. Waidner, E. F. Mueller, and Paul D. Foote, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2051.

CHARLES E. GUILLAUME,\* Sèvres, France (written discussion†).—Referring to p. 2052, experiments made at the end of the year 1884 showed a remarkable agreement between the indications of various verre dur thermometers of which all the corrections had been determined with the greatest possible precision. The maximum deviations not attributable to the comparisons themselves were then about 0.002 to 0.003 degree. Much later, greater differences began to show. They were caused by the fact that the glassmaker had modified the composition by adding to it a small quantity of lead. Efforts are now being made in France to obtain a regular supply of glass made according to the old formula.

The determination of the boiling point of sulfur made by Chappuis,<sup>1</sup> 444.6°, accords very well with the value noted on p. 2054.

The International Committee of Weights and Measures and the General Conference have already considered the future abandonment of the hydrogen scale in favor of the thermodynamic scale. The hydrogen scale appears to be, in their estimation, a transitory one, happily so closely approaching the final scale that no correction should be necessary for all measurements of temperature made during the last 30 years.

It must not be forgotten that the decision reached by the Inter-

<sup>2</sup> J. R. Cain and Earl Pettijohn: A Critical Study of the Ledebur Method for Determining Oxygen in Steel. Bureau of Standards *Tech. Paper* 118 (1919).

\* Bureau International des Poids et Mesures.

† Received Oct. 11, 1919. Translated from the French.

<sup>1</sup> Bureau International, *Travaux et Mémoires*, 16.

national Committee in 1887, and endorsed by the Conference of 1889, applied only to the international service of weights and measures; that is to say, the domain of temperatures where the hydrogen scale or the thermodynamic scale presents divergences which are, up to date, within the limit of measurable quantities. But it is not at all contrary to this decision to adopt other representations in the region outside of the one expressly indicated. At very low temperatures, the best representation that one can at the present time propose is undoubtedly that furnished by the helium thermometer; and at high temperatures, hydrogen has such a tendency to diffuse that it is necessary to replace it by another gas. But then the errors in reference to the thermodynamic scale are considerable enough to necessitate a correction. All our efforts ought to tend now to determining the corrections in such a way as to extend the realization of the thermometric scale far into the region where the nitrogen thermometer, for example, overlaps the radiation pyrometer. As the authors say, the latter is the only thing that one can use for high temperatures, whichever law is applied. It may be noted that, the fundamental points of a nitrogen thermometer under low initial pressure having been chosen, for example, at the boiling point of water and at the boiling point of sulfur, the linear extrapolation toward high temperatures will give a scale very close to the thermodynamic scale. It would seem possible to make a direct experimental determination of corrections by the comparison of two nitrogen thermometers having very different initial pressures.

On p. 2062, the authors mention the old measure of Holborn and Valentiner of the melting temperature of platinum. However, this old value seems to have been abandoned by the Reichsanstalt, see p. 2057. On the other hand, Harker indicated a much lower temperature for the melting of platinum; but the process that he employed in his determination leads one to think that he used a metal containing an appreciable amount of carbon in solution, either in the form of carbon or in the form of platinum carbide.

LEASON H. ADAMS,\* Washington, D. C. (written discussion†).—It would be difficult to point to anything more vitally important to the industries and to scientific research than a temperature scale that is trustworthy and reproducible. This paper is a clear and illuminating exposition of the present state of our knowledge of the scale of temperature and it is pleasing to note that, by means of the standard scale which the authors present, temperatures may now be defined with such satisfactory precision. Thus at room temperatures the possible uncertainty in the absolute magnitude of a given temperature need not be greater than

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\* Physical Chemist, Geophysical Laboratory.

† Received Sept. 25, 1919.

a few thousandths of a degree; at 400° C., the maximum error is not more than a few hundredths of a degree; and at 1100°, a few tenths.

Above 1100°, the determination of the temperature scale hinges largely upon the melting point of palladium, which is taken as 1550°, although the average as obtained by several independent investigators is somewhat higher. As pointed out by the authors, in only one of the investigations, that of Day and Sosman, was the purity of the palladium determined. This circumstance brings to mind certain observations I made some time ago on the difference in melting point of three samples of palladium wire, one of which was drawn from a piece of the metal used by Day and Sosman. The melting points were determined with a platinum-platinrhodium thermocouple using the wire method. One sample melted 2° and another 12° higher than the Day and Sosman palladium, which according to the analysis was very pure, and the thermoelectric properties of the three kinds gave a qualitative support to the conclusion that as a rule the purest palladium has the lowest melting point. This being the case, it is not at all improbable that some of the higher values that have been obtained for the melting point of palladium are influenced by lack of purity of the material, and this supposition lends support to the lower value, 1550°, which the Bureau of Standards has very wisely chosen.

The scale of temperature, as given, terminates at the lower end at -40°. It is to be hoped that the Bureau of Standards will, as soon as feasible, extend the standard scale down to liquid-air temperatures or below.

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### Petroliferous Provinces

Discussion of the paper of E. G. WOODRUFF, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 156, June, 1919, p. 907.

IRVING PERRINE, Hutchinson, Kans.—I think in reading this paper one should bear in mind its relation to Dr. David White's paper on "Some Relations in Origin between Coal and Petroleum."<sup>1</sup> In that paper he discusses the relationship between the percentages of fixed carbon in the coals, the gravities of the oils, and commercial gas possibilities. His paper has a map showing certain areas which Dr. White believes to be hopeless as far as oil and gas possibilities are concerned.

THE CHAIRMAN (C. W. WASHBURN, New York, N. Y.).—I would like to emphasize one point brought out by Professor Schuchert.<sup>2</sup> The southern hemisphere has had an exceedingly monotonous geological history, except the northern border of Africa, the eastern border of Aus-

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<sup>1</sup> *Jnl. Washington Acad. Sciences* (Mar. 19, 1915).

<sup>2</sup> *Min. & Met.* (Nov., 1919).

tralia, and the western and northern borders of South America. In other parts of these continents there has been little deposition of marine sediments and very little deformation since Paleozoic time. Therefore they are not attractive places to the prospector for oil.

There is probably truth in Schuchert's idea that the composition of the sea water may have had something to do with the preservation of organic matter. I followed the outcrop of an oil sand about 700 kilometers along the western coast of Africa. The fossils in it are exceedingly minute, showing that the condition of the sea water was not suitable for vigorous life, the oysters are not much larger than the head of a lead pencil, and nearly all forms are dwarfs. In Madagascar there is the same formation with similar faunal conditions. If the water in semi-enclosed basins is very salty water, bacteria cannot thrive in it much better than the molluscan forms of life. This is probably an indication that the composition of the sea water in enclosed basins may have something to do with the preservation of fats and waxes in the sediments of certain areas.

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### Height of Gas Cap in Safety Lamp

Discussion of the paper of C. M. YOUNG, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* 152, August, 1919, p. 1207.

JAMES ASHWORTH, Livingstone, Alberta, Can. (written discussion\*).—About the year 1878, the writer commenced to experiment on safety lamps, the results of which will be found in the Transactions of the North of England Institute of Mining and Mechanical Engineers 1879-1880, the Transactions of the Manchester Geological and Mining Society, and in the technical press. He has also made a careful investigation of the flame caps produced by chemically prepared methane when mixed with air in accurately measured percentages. Before the conclusion of these experiments he personally fitted the hydrogen gas test to a special pattern of the Ashworth-Gray patent safety lamp.

Later, as pure hydrogen gas was not always available, the writer constructed a safety lamp that would separately burn oil and alcohol; and still later, a somewhat similar lamp to burn alcohol only for specially testing low percentages of methane. This lamp was known as the Ashworth alcohol safety lamp.

The Ashworth alcohol lamp, having a conical glass 4 in. high, gives just room enough for the cap from 1 per cent. of methane, which is 3 in. high above the cone over the wick flame. The cap for  $\frac{1}{2}$  per cent. of

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\* Received Oct. 29, 1919.

methane is  $1\frac{3}{4}$  in. high, and for  $\frac{1}{4}$  per cent.  $1\frac{1}{4}$  in. high. Each of these caps is well defined.

The sketch of the apparatus used by Mr. Young does not show that he adopted any means to bring the methane mixture into close contact with his eight coils of platinum wire. It would, therefore, appear to the writer that in this respect his tests were not as accurate as they might have been and that this fact will account for the non-uniformity in the height of the caps produced. Those who are acquainted with the caps produced by the Ashworth-Clowes hydrogen flame know that the tips of the flame caps are very distinct and that the tips of the caps form a straight and not a curved line, due to the increasing percentages of methane. This is, in either case, due to the increase in the temperature of the methane flame resulting from the increase in the volume of combustible gas.

In the Ashworth-Clowes, hydrogen, gas-testing, safety lamp the influence of the temperature of the testing flame is made use of by making two scales of flame caps. The flame for testing percentages above 1 per cent. may be made with a 10-mm. hydrogen flame cap and those under 1 per cent. with a flame 15 mm. high; in this way the cap produced by  $\frac{1}{4}$  per cent. of methane can be easily seen.

Mr. Young states that he "knows of no previous attempt to correlate the changes of the temperature with change of the height of the cap produced." In this regard it is evident that the use of two or more heights of the hydrogen flame in the Ashworth-Clowes lamp effects this in a simple and practical way, but without registering the actual heat of the flame; although the heat of each size of flame may become a standard one, and in practice is so. The writer regrets that he cannot see the novelty claimed by Mr. Young; viz., that he has discovered that there is a fairly definite relation between the temperature of the source of ignition and the height of the cap formed in a mixture of a combustible gas and air, the height of the cap increasing with the temperature. In this regard the height of the 10-mm. hydrogen flame, say, for 1 per cent. of methane with the height of the cap produced by a 15-mm. flame may be compared.

If Mr. Young were to use a conical glass, blackened (smoked) over its inner surface behind the testing flame, and with a chimney a few inches high on the top of it, he would find the tip of his flame caps sharply defined and easy to measure. All safety lamps used by fire-bosses are greatly improved in their firedamp indications if, say, one-third of the inner surface of the glass part is either colored a dead black, or is smoked so as to deaden the reflection on the usual bright surface.

### Manufacture and Electrical Properties of Manganin

Discussion of the paper of F. E. BASH, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1717.

F. G. SMITH, Waterbury, Conn.—I would like to ask whether small amounts of iron give the maximum resistance at a low temperature, and if the large amounts of iron raise the temperature at which the maximum resistance occurs? That is, with a small amount of iron, will a maximum be at, say,  $10^{\circ}$ ?

F. E. BASH.—With the small amount of iron, the maximum is at a lower temperature, and with the increase of iron, the maximum increases; it seems to come to a maximum and then decrease; that is, increasing the iron up to a certain value increases the temperature at which there is a maximum of resistance, and any increase of iron beyond that value will start decreasing this temperature. With 2 per cent. of iron, the maximum is lower than for 1.5 per cent. which was the value that we found to be satisfactory.

F. L. DRIVER,\* Jr., Harrison, N. J.—I would like to ask what chance there is of the instrument companies getting together and deciding on standards for both manganin and constantan? We make both of these alloys in this country and we find that each one of the instrument companies who buy these materials require different standards of specific electrical resistance and thermal e.m.f. For instance, some of our customers require an electrical resistance in manganin or therlo of 240 ohms per circular mil foot and others require it with a specific electrical resistance of 270 ohms per circular mil foot. They buy these alloys in relatively small quantities so that it means much extra melting and supervision when making up small quantities for each consumer. If something could be done to eliminate this, it would be a benefit to the instrument companies, who could secure their material more cheaply, and to the manufacturers, who would not have to spend so much time and effort in special manufacturing.

F. E. BASH.—Nothing has been done to standardize these metals, though I see no reason why something could not be decided upon in that respect. The specific resistance can be varied by varying the amount of manganese in the material, and so far as resistance is concerned we are primarily interested in having the proper temperature

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\*Third Vice-President, Driver-Harris Co.

coefficient, but the lower the specific resistance, the more wire it is necessary to put on our spool, so that we are also interested in having a high specific resistance. The value that we prefer is 250 ohms per mil foot.

THE CHAIRMAN (W. H. BASSETT, Waterbury Conn.).—Have you investigated any manganin that contained no nickel?

F. E. BASH.—Only in one case; that sample had a very good coefficient. I think that you can get a good coefficient by a number of formulas; we started with values found in some handbooks and experimented with them until we found a good one. As it was very important that we produce the wire in a hurry, we could not take the time to experiment extensively. If we had had the time, we could have gone very much more deeply into the subject, but we carried it just far enough to get a good coefficient and let it go at that.

### Recent Improvements in Pyrometry

Discussion of the paper of R. P. BROWN, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1979.

A. O. ASHMAN, Palmerton, Pa. (written discussion\*)—From a theoretical point of view the best method to maintain the cold junction at a constant temperature is by means of a pipe driven in the ground, to which the so-called cold-junction compensating leads are run, and of course there are many times and places where it can be successfully used. There are, however, several objections to this method. In the vicinity of any furnace there are apt to be underground flues for preheated air or gases, recuperators, water mains, etc., which will eliminate the probability of a constant temperature. These, of course, can be avoided by carrying the leads to distant locations known to be free, but this is not good practice because the so-called compensating leads have a rather high resistance, which materially affects the accuracy of even the high resistance instruments, unless they are specially calibrated for it. Moreover, the cost of these long leads is almost prohibitive. A better way is to run short lengths of compensating leads to electrically heated constant-temperature boxes conveniently located near the furnace in a place that is of fairly uniform temperature. These boxes are on the market and can be procured at a cost that is approximately equal to the cost of 100 ft. of compensating leads. They can be connected to any power or lighting circuit and once set require very little care. One box will accommodate a number of couples.

An additional disadvantage of the buried pipe is that moisture or water may accumulate in it. This is hard to detect and almost im-

\* Received Sept. 25, 1919.

possible to remove. It generally gives rise to galvanic effects which result in errors that are greater than those due to an uncorrected cold junction.

While the term "compensating leads" is in general use, it is not justifiable, as there is no compensation in the true sense of the word. For example, suppose the cold junction of a couple was exposed to a temperature of 100° higher than the couple was calibrated for. If the ends of the leads connected to this couple were in the same region there would, of course, be no compensation as when a true compensator was used. A better term, I think, would be cold-junction extension leads. Many terms in pyrometry are more or less loosely used, which could be standardized by suitable action on the part of some interested society.

### Physical Properties of Nickel

Discussion of the paper of D. H. BROWNE and J. F. THOMPSON, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2693.

J. L. JONES,\* Pittsburgh, Pa.—If a nickel anode is cast under commercial conditions, will it contain nickel oxide? Will the nickel oxide affect the rate of corrosion in a double sulfate solution; or will the nickel oxide dissolve in a double sulfate solution? I would also like to ask whether a 98 per cent. pure nickel anode will corrode as fast as a 96 per cent. nickel anode; whether electrolytic nickel will corrode less rapidly than nickel containing a small amount of carbon; and whether the materials sometimes used in coating molds for casting nickel anodes will affect the rate of corrosion of the anode? In other words, whether an electrically non-conducting coating is likely to be present that will prevent the nickel anode from corroding rapidly.

JOHN F. THOMPSON.—The nickel oxide will not dissolve in the double sulfate solution, as far as we know. We do not make the ordinary nickel anode of commerce, but we supply nickel to the nickel anode makers. Those makers almost invariably buy a high-carbon nickel shot, ranging around 0.45 per cent. carbon. In their process, they even further carburize it so as to get nickel that will melt easily and be fluid enough to fill the mold, so that the ordinary cast anode on the market is unquestionably oxide free. The only time that such an anode will have oxide will be through an error in melting. Some cupola makers of anodes have had trouble with oxidation, but as a rule the anodes are thoroughly carburized; so much so that they probably carry a couple of per cent. of carbon of which around 1.6 per cent. is graphite.

\* Metallurgist, Westinghouse Elec. & Mfg. Co.

It is supposed by the anode makers that the anode containing carbon dissolves more readily than the carbon-free anode. This belief, I think, is pretty well supported.

With regard to the facing, I don't know; but this fact may be of interest to you: very often the surface of nickel shot when used in a basket anode will not dissolve so that the shot does not go into solution readily until a small hole is started through the skin, and then the metal inside of the shot will leak out and leave the outside skin.

J. L. JONES.—Is its microstructure different from the rest?

J. F. THOMPSON.—I do not know; I do not know what causes it.

J. L. JONES.—Do you think a similar condition would prevail in a mold that was very cold in comparison with nickel cast in a mold that was hot; would there be a difference in microstructure, possibly?

J. F. THOMPSON.—I think so. This fact I ran across only about 10 days ago, and I do not know the reason for it.

R. S. MACPHERRAN.—Was there any oxide outside of those shots; was there anything that would stop the solution?

J. F. THOMPSON.—No, the shot was perfectly bright and was made by swinging a spout over a big tank of cold water, so that the shot had a short fall. The surface appearance of the shot was perfectly white, even in the case of this shot where the internal erosions took place.

Mr. Jones asked about the electrolytic nickel. As far as we know, there is no difficulty in using electrolytic nickel as an anode for plating. Some people use it for that purpose.

W. H. BASSETT,\* Waterbury, Conn.—Nickel cathodes when used as anodes in plating solutions do not dissolve as rapidly as ordinary cast anodes. When cathodes are used as anodes the nickel solutions become impoverished. It was impossible to make nickel cathodes give results equal to those obtained with cast anodes and it was found, upon investigation, that the trouble was due to the solutions becoming impoverished in nickel. Malleable nickel will act in exactly the same way, and the solution of malleable nickel anodes was found to be very much slower than that of cathode nickel when used as anodes.

J. F. THOMPSON.—I am interested in that statement. In foreign practice, they use a great deal of rolled malleable nickel. I don't know how they get it dissolved, but they say that for the last 10 years there has been quite a demand over there for rolled anodes.

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\* Technical Superintendent and Metallurgist, American Brass Co.

W. B. PRICE,\* Waterbury, Conn.—The old method was to use double nickel salts; then, when using single nickel salts with the rolled nickel anodes they also introduce into the electrolyte nickel chloride, which seems to produce an active corrosion of the anodes, which doesn't take place in the old double nickel salts solution.

### Melting Point of Refractory Materials

Discussion of the paper of L. J. DANA, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1571.

J. S. UNGER,† Pittsburgh, Pa. (written discussion‡).—Firebricks intended for the same purpose, but supplied by different manufacturers, may be of entirely different clays, contain different proportions of flint, calcined and plastic clays; the particles may vary widely in size; the water used to make the brick will vary; the pressure in molding will vary, depending on whether the brick is hand made or power pressed; and the degree of burning in the same kiln will differ. These variables affect the melting point and the strength of the brick when heated.

An important property of a firebrick is its ability to resist heat and, at the same time, weight or load without serious deformation. The softening point and the melting point of a firebrick may be several hundred degrees apart, and two bricks may show considerable difference in their softening points, but the melting points may be approximately the same. Bricks are not usually employed at temperatures close to their melting points. If they must withstand very high temperatures, the firebrick is discarded and a brick of more refractory material is used. Under these conditions it is doubtful whether the determination of the melting point of a brick has much practical value.

If the determination of the melting point is necessary, the test should be made on a portion of the original brick and not on a specially prepared sample. A small triangular pyramid with a base about  $1\frac{1}{2}$  in. and 3 in. high can be sawed from the corner of the brick with a thin-bladed carborundum wheel, without injuring or destroying the size of particles, the bond, or degree of burning of the original brick. This specimen can then be compared with standard Seger cones or tested by any other method desired.

\* Chief Chemist and Metallurgist, Scovil Mfg. Co.

† Manager, Central Research Bureau.

‡ Received Sept. 25, 1919.

### Manufacture and Properties of Light-wall Structural Tubing

Discussion of the paper of H. J. FRENCH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1855.

W. P. PUTNAM, Detroit, Mich.—There is one company that is heating these tubes in an upright position by passing electrical energy directly through the tube itself. The lower connection is attached to an indicator, which shows the point at which the steel passes through the critical range. At that point the clamps are released and the tube is dropped into a well of oil. This method simplifies the heat treatment of tubes in long lengths.

H. J. FRENCH.—I am not entirely familiar with the method outlined, but it appears to have one serious disadvantage; that is, the length of tubing that is directly connected with the electrical contacts is wasted and must be cut off due to either heavy oxidation or burning. That is a serious difficulty, if true in all cases, and cannot be overcome, inasmuch as it is very difficult to draw long tubes of thin wall. Having once obtained a lot of tubes, to cut, say 14 ft. in length, there is often little excess metal available to discard. Am I correct concerning the burning or heavy oxidation of the metal where it comes in contact with the tube.

W. P. PUTNAM.—I have no information regarding the burning; it is, however, necessary to discard the ends of the tube at the point of contact with the electrodes.

H. J. FRENCH.—In one method being developed at the present time these tubes are placed in racks, similar to those used in galvanizing pipe in some plants. These racks, with the tubes, which in effect give greater mass to the material to be treated, are placed vertically in an electrically heated chamber, removed by a crane, and the entire apparatus is immersed in the oil.

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### Heat Treatment of Cast Steel

Discussion of the paper of J. H. HALL, A. E. NISSEN, and K. TAYLOR, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2881.

H. M. HOWE, Bedford Hills, N. Y.—We may clear the matter very easily, at least to a very great extent, if we look at these islands of ferrite that occur in steel castings as simply corresponding to the ferrite ghosts in steel forgings, representing the differentiation that takes place in the solidification of the molten mass. In that solidification you have dendritic crystals forming and in between those dendrites you have con-

centrated the non-ferrous substances. Some of those substances, notably phosphorus and oxygen, have the power of increasing the quantity of ferrite that forms where those dendritic places persist. The fillings between the dendrites are enriched in phosphorus or oxygen, and are removed by diffusion in annealing extremely slowly. Carbon diffuses itself in steel with astonishing rapidity. The distance it migrates in a very short while is extraordinary, but phosphorus and oxygen apparently move slowly from the place in which they have been concentrated in freezing, so that unless you heat to a very high temperature and for a great length of time, annealing does not have any appreciable effect on the local enrichment in steel castings.

What is the effect of phosphorus or oxygen and how does it come that a local concentration of phosphorus or oxygen has the power to create a greater proportion of ferrite than should be normally present? It seems to me that a simple explanation is that phosphorus or the oxygen shifts the eutectoid point to the right. That is to say, in the presence of phosphorus or oxygen, pearlite has a much higher carbon content than in their absence, with the result that for a given carbon content of the steel as a whole, there is a smaller content of pearlite and a larger content of proeutectoid ferrite. Where there is a ghost there is a concentration of oxygen or phosphorus, and this concentration by raising the eutectoid ratio of carbon gives locally a larger proportion of ferrite than exists elsewhere in the mass.

I think Mr. Hall is right in crediting that high-manganese steel to Mr. Maunsel White, who discovered it some 25 yr. ago. That has been overlooked to a surprising extent. Mr. Abbott called our attention to it in a paper 6 or 7 yr. ago. I think it is very interesting to look at that manganese as simply representing the equivalent of nickel. A 12 per cent. manganese steel is not far from the equivalent of 25 per cent. nickel steel; 1 per cent. manganese does very much more cheaply the work of 2 per cent. nickel. So, if you look at this  $1\frac{1}{2}$  per cent. manganese steel as corresponding to a 3 per cent. nickel steel, you wonder that people have passed it by so long.

P. H. BRACE, Pittsburgh, Pa.—Dr. Howe, do you consider that the oxygen is in the solid solution? In the laboratory of the Westinghouse Elec. and Mfg. Co. we have done some work on the gases in steels and find indications that at the high temperatures reactions that generate gases take place.

H. M. HOWE.—I think the phenomena are quite compatible with the idea that it is a case of solid solution of the oxygen, which at high temperatures might react on the carbon. If the oxygen was not in solid solution but there was a foreign body, it is a little hard to see why it should have its specific effect on the properties of the steel.

### Manufacture of Steel Rails

Discussion of the paper of R. W. HUNT, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2339.

G. B. WATERHOUSE,\* Buffalo, N. Y. (written discussion†).—One of the most essential features of rail manufacture is the production of rails that will give good service and be free from failures. To this end rails are made to careful specifications and their manufacture is controlled by rigid inspection on the part of both the producing mill and the railroad or its representative, such as the Hunt special inspection referred to in the paper.

Captain Hunt refers to the crescent-shape base failures and describes them as ruptures in the rail flanges extending from the outside inward toward the web. This is hardly correct and may be misleading. It has been shown, over and over again, that the base breaks originating in seams invariably start at the center of the rail base, and run longitudinally in varying lengths from 3 to 12 in. and sometimes longer. Most of them are from 5 to 8 in. long and then curve outward to the edge of the flange. The split at the center of the base may exist for an indefinite time and not be discovered until the break shows on top of the flange or the piece of flange breaks off. The stresses that cause the break are explained in two ways: (1) by the eccentric bearing of the rail base, that is taking contact at one side or edge and bringing excessive strain at the center of the base which starts fracture in any seam that may be present at that point; (2) the split may be due to cross strain in the base where this member is thrown into compression, as happens where a pair of trucks are on opposite sides of the cross tie or rail-base bearing, and the head is put in tension.

A careful study of "split base breaks" shows that fully 95 per cent. occur on the tie bearing, which is further evidence that the above described causes for the initial break are probably correct. These split base breaks are almost invariably progressive, but always start at the center of the rail-base running longitudinally.

A decided advance in rail production was the invention of the deseaming machine of the Lackawanna Steel Co., referred to by Captain Hunt. It was developed in 1913 and put into use Jan. 14, 1914, deseaming the bottom of the base only. On July 13, the company began to deseam both head and base and the machine has been in constant operation ever since. The amount of rails deseamed is approximately 1,000,000 tons. The machine was thoroughly described by Captain Hunt in a paper read before the American Society of Mechanical Engineers, December, 1914, but a brief description here may be of interest.

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\* Metallurgical Engineer, Lackawanna Steel Co. † Received Sept. 23, 1919.

The process consists essentially of milling off sufficient of the surface of the head and base of the rail bar, while hot and during the rolling, to secure freedom from surface defects. Not only are the seams eliminated, but the softer partly decarburized surface also, so that the rolls in the remaining passes do their work on the true higher carbon steel of the rail bar. The rail bar, with head down, is forced between two saw disks by a pair of driven pinch rolls, adjustable to bars of various sizes and having guides for the top, bottom, and sides of the bar. Adjustment at the saws is made for a cut  $\frac{1}{8}$  in. or, at the most  $\frac{3}{16}$  in., deep. A second set of pinch driven rolls, on the delivery side, helps to force the bar against the cut of the saw teeth. Here, a second set of guides helps to hold the bar rigidly and firmly during passage through the saw. From the second set of pinch rolls, the bar goes along the table to the finishing rolls and receives five finishing passes. The hot rail bars enter the machine at a speed of about 350 ft. per min., are slowed down by the cutting operation to about 80 ft. per min. and on leaving the saw rapidly pick up speed until they enter the finishing stand at about 500 ft. per min. Both saw disks are approximately 8 in. wide and are belt driven from motors. They are 5 ft. diameter, with V-shaped teeth of  $\frac{3}{4}$  in. pitch. The peripheral speed is 25,000 ft. per min. The teeth stand up well, and the saws mill at least 30,000 tons of rails without dressing.

The main objects of this process are the production of rails with the top of the head and the bottom of the base free from seams and surface defects, thus exposing to the wheel pressures solid clean metal free from decarburized weak surface material. The improvement in head surface is of special importance in regard to wear and flow of metal. The deseaming gives the user the benefit of hard homogeneous metal at the top surface of the rail head in the initial use, which will not break down or crush over the corner of the head, as often takes place with rails that have not been deseamed. This is most desirable as it pertains to the running and service; but the improvement in the base, as a safeguard against the danger of breakage, is far more important.

It is probable that the split base failure has existed to some extent ever since T rails were put into use, but it first received special attention after A. S. C. E. Standard Sections were adopted and tie plates became a part of standard track constructions. The A. S. C. E. sections were revised into the A. R. A. sections having a thicker base. This, no doubt, reduced base failures; the use of open-hearth steel also helped a great deal. None of these revisions, however, have completely overcome base failures. The deseaming process has been very successful in this respect.

The statistics for rail failures, mentioned by Captain Hunt, give information on this point. This is not all the tonnage made, but is all the tonnage on which there is information. There were only two total base failures in the 112,936 tons of Lackawanna open-hearth rails rolled in

1914; only four in the 112,397 tons rolled in 1915; four in the 141,966 tons rolled in 1916; and none so far reported from the 97,558 tons rolled in 1917. The statistics available to date are to Oct. 31, 1917. The deseaming process was started January, 1914. Out of the 219,376 tons rolled in 1913, which were not deseamed, sixty-two base failures have been reported to date. In other words, out of approximately 500,000 tons of rails reported on only ten base failures have developed, which is a very striking result. The results with five other mills over the same space of time is 249 base failures out of approximately 3,000,000 tons of rails.

H. T. DOUGLAS, JR.,\* Chicago, Ill.—In the fall of 1915, at the suggestion of Captain Hunt, for whose professional ability we have very great respect, we accepted a carload of rails, for purely experimental purposes, that had not been subjected to the straightening cold process.

He selected a carload of this rail which was placed in our south-bound main line track, about 5 mi. south of Bloomington, Ill., where the trains attain high velocities. The trackmen were not advised that this rail was different from the others they were receiving at the time, and they did not discover any difference in it. This rail was applied in the winter of 1915. If any of you would like to inspect these rails, we should be pleased to show them to you. The track was put up on our standard section, 12 in. of crushed rock. I saw this track and critically examined the rail two days ago: first, on the ground, and, afterward, on a high-speed train. If you were to see the high merits of this rail, it would appeal to you; we are very much pleased with the results and hope that after a while we may use no other rail. In the last shipment of rails this year, we requested Captain Hunt to send a carload of this rail, which is now on our main line tracks. The track is in beautiful alignment and surface, and I don't think it is possible for a train to ride more smoothly than the one I observed moving at 60 mi. an hour over this test rail.

### Heat Treatment of Aluminum-alloy Castings

Discussion of the paper of ZAY JEFFRIES and W. A. GIBSON, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2493.

G. K. BURGESS,† Washington, D. C.—At the Bureau of Standards it was decided, in order to study the high-aluminum end of these curves, that efforts should be made to prepare pure aluminum, and the promise of getting aluminum practically free from the two elements that have such great effect in very small quantities, namely, silicon and iron, and which

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\* Chief Engineer, Chicago & Alton R. R.

† Chief, Division of Metallurgy, U. S. Bureau of Standards.

practically always occur with the aluminum, is very good. We are hoping that within a reasonable time we will have aluminum practically free from these elements.

PAUL D. MERICA, Bayonne, N. J.—In a recent article before the American Society for Testing Materials,<sup>1</sup> I ventured the prediction that the heat treatment of light alloy castings of aluminum containing copper would have commercial possibilities owing to the marked improvement in the mechanical properties of these alloys produced by it. I am glad to find this opinion confirmed by the results of the tests that the authors have just presented. These agree essentially with those of the above article and show that an increase of from 0 to 50 per cent. in tensile strength together with an increase of from 0 to 100 per cent. in elongation may be obtained by heating such alloys to 500° C., quenching in oil, and aging for some time either at ordinary temperatures or at about 100° C. It is hardly necessary to point out the advantages for various purposes of these improved mechanical properties.

At the time of carrying out my tests I was somewhat in doubt whether castings of complicated shape could successfully be quenched from 500° without cracking and, therefore, subjected the specimens to the less drastic treatment of heating to 500°, cooling in air, and aging. This treatment gave results not markedly inferior to those shown by the authors, as far as tensile strength improvement is concerned, but much less uniform in respect to elongation. This, however, I am now inclined to attribute, following the authors' suggestion, to poor heating conditions allowing internal oxidation. I should be interested to know the authors' opinion as to whether small commercial castings could withstand without cracking or warping the rather drastic heat treatment they have adopted. In case this should not be the case I believe that the application of their method of heating in niter, to prevent oxidation in conjunction with air-cooling and aging, might give results as good as those produced by quenching.

The decrease in the visible amount of free  $\text{CuAl}_2$  in the alloys produced by the heat treatment has been noted by the authors and fits in well, apparently, with a theory of the mechanism of heat treatment of these alloys that I have advanced in preceding papers.

I should also like to offer the suggestion that the structure, which Mr. Gibson has described, consists of grains of aluminum with a eutectic network of iron-aluminum compound, or iron-aluminum compound plus aluminum-copper compound. I think the suggestion of the authors was that this network might have been precipitated after solidification.

This structure is one with which all are familiar who have had anything to do with that of 88-10-2 bronze. In such bronzes large grains

<sup>1</sup> P. D. Merica and C. P. Karr: Some Tests of Light Aluminum Casting Alloys; Effect of Heat Treatment. *Proc. Am. Soc. Test. Mat.* (1919).

are obtained with a pronounced network within the grains; each grain consists of a dendritic crystal between the branches of which the eutectic has solidified later than the branches themselves. It would appear that the structure of the aluminum cast alloys is entirely similar in origin, and that the network is a real eutectic formed in a natural manner.

W. A. GIBSON.—In other words, you believe that the network is simply a discontinuous eutectic.

P. D. MERICA.—Yes, discontinuous network.

C. P. KARR,\* Washington, D. C.—On the work conducted by Dr. Merica and myself, we cast a number of these alloys at various temperatures, from about 670° up to 950°, and in one of his experiments some of the bars were poured at 950° and the heat held until the temperature dropped down to 650° and to 700°. The test bars cast at the higher temperature gave a very much lower result. At 700°, pouring from the same heat of metal, we obtained possibly the maximum physical properties of which the casting was capable. I would like to ask Mr. Gibson if he observed the pouring temperatures of the bars which he presented in his paper?

W. A. GIBSON.—The maximum furnace temperature was kept at 1400° F., plus or minus about 15°, and the pouring temperature was kept at 1300° in the ladle, that is, just before it was poured. The limits on this latter temperature would be plus or minus 5° or 10° variation.

H. S. RAWDON,\* Washington, D. C.—It seems to me rather a nice way of looking at the structure is to think of each individual crystal as a pine tree. When these are jumbled together, you have just as many spaces between the branches as you have between the trees themselves; so there is really no more reason for the eutectic to collect at the boundary of the crystal than there is for it to collect in the spaces between the little branches of the trees. The micrographs do not suggest, strongly at least, that that second constituent comes out of the solid solution, rather it is the eutectic that forms from the molten residue after the formation of the trees, each tree being a tiny crystal in itself.

LEON McCULLOCH.—I would suggest that these crystalline boundaries are not solid materials but voids formed by gases liberated during solidification.

P. D. MERICA.—As far as the alloys I have examined are concerned, the gas cavities, of which there may be a few present, are never present in that form, but in that of small rounded spots which are not usually

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\* Associate Physicist, U. S. Bureau of Standards.

numerous. Furthermore, the crystalline boundaries are not visible until after etching, as they should be if they are actual cavities.

W. A. GIBSON.—Of course the size of hole that can be seen under a microscope is limited only by the resolving power of the microscope and the polishing and etching of the sample. However, the cavities to which I referred as being penetrated by gas are smaller than can be seen by the ordinary microscope using, for example, 1000 diameters. There are usually a few holes visible in any section of aluminum. In inferior castings these holes may even be visible to the naked eye, but gas will pass through openings which are much smaller than those ordinarily visible in an aluminum casting under the best microscope.

The gentleman may have been misled by the appearance of Fig. 9. The black spots shown in this micrograph are not holes, but  $\text{CuAl}_2$ . It is to be noted that, in the type of etching given, the copper compound is black instead of light gray as in the sodium hydroxide etching given by Dr. Merica.

P. D. MERICA.—Will small castings of complicated design actually stand quenching in water without warping or cracking?

W. A. GIBSON.—Some cooling stresses would be set up, but nothing at all comparable to what you get in steel; I would not anticipate any difficulty in that direction. Our experience has shown that cooling in water or in oil will give better results than cooling in air, but we did not carry our experiments on air cooling very far because they did not seem to give much promise.

### Five Foundry Tests of Zinc Bronzes

Discussion of the paper of C. P. KARR, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2485.

W. M. CORSE, Mansfield, Ohio.—We have sometimes seen in individual tests ultimate tensile strengths as high as 55,000 lb. per sq. in. being attained under electric furnace practice. These results, of course, average much lower than that, but with better methods of melting, can we hope to get the strength up to somewhere near the figure attained by these individual tests?

C. P. KARR.—Yes, because with the electric furnace you can lessen the oxidation by means of the impurities always found in the melting. But one of the most important things in making 88-10-2 bronze of this class is to use a core-sand mold with a very open grain, so that the

gases carried down will have a chance to escape through the sand, and thus increase the tensile strength.

THE CHAIRMAN (W. H. BASSETT, Waterbury, Conn.).—Do I understand that pouring temperatures of  $1120^{\circ}$  to  $1270^{\circ}$  gave equally good results and with variations beyond the temperatures either way, the properties are affected?

C. P. KARR.—If you go much below  $1100^{\circ}$  you will not get very high results. If you go above  $1270^{\circ}$  you will have some of the oxidation products in the metal. Professor Carpenter carried my experiment further and heated some of the metal up to  $1450^{\circ}$  and allowed the metal to cool in the pot to somewhat below  $1270^{\circ}$ . The original valuable properties of the metal were restored, while the metal was cooled back within that temperature range, which was certainly a very remarkable discovery.

W. M. CORSE.—With 88-10-2 bronze in very thin castings, it seems very difficult to get the elongations specified by the Navy specifications, 14 and 15 per cent. I would like to ask Mr. McKinney if he has had similar experiences with thin castings of this metal?

P. E. MCKINNEY,\* Washington, D. C.—Of all the metals we handle, probably the red bronzes, containing approximately 10 per cent. of tin, are the most delicate and susceptible to slight changes in foundry practice, and the range is so very close that the restricting of the size of the gate or the increasing of the temperature by very slight margins will very frequently destroy the entire object sought; that is, the elongation will suddenly drop to nothing and you will have a fracture either in the casting, or the test bar, that is entirely crystalline and apparently rather segregated. I think Mr. Karr's paper has shown very clearly that very small changes in practice effect big changes in the results obtained, a great deal more than in the case of some of the bronzes that don't have the excess of free eutectic that will freeze out and give us erratic grain conditions and intercrystalline cracks and various troubles of that kind. Mr. Corse's question requires every individual casting to be considered on its own merits, and foundry practice developed for that casting that is typical of that casting alone.

Mr. Karr states that the test bar used in the experiments was a design of my own. I would like to correct that impression, because while we have used it, the design is practically identical with the original Webert bar.

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\* Chemist and Metallurgist, U. S. Naval Gun Factory.

### Some Factors Affecting the Usefulness of Base-metal Thermocouples

Discussion of the paper of O. L. KOWALKE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No 153, September, 1919, p. 1751

T. R. HARRISON, Washington, D. C. (written discussion).\*—Mr. Kowalke shows that a high resistance millivoltmeter is subject to smaller errors, due to change in resistance of the thermocouple to which it is attached, than is a low-resistance instrument. He uses as examples instruments having resistances of 30 and 2 ohms, respectively. At the Bureau of Standards, resistances above 300 ohms would be considered high and 30 ohms rather low.

In the tests on calorized-iron thermocouples, a difference between the first and third calibrations of the couples serves to show changes due to the intermediate heat treatment and only under certain conditions would changes in calibrations due to changes in the wire be detected by a recalibration after  $1\frac{1}{2}$  in. had been cut from the hot-junction end of the couple and the ends rewelded.

The calibration of a couple depends only on the thermoelectric properties of that part of the couple which lies within the region of non-uniform temperature, i.e., the temperature gradient; hence, so long as the temperature gradient falls along wires of similar thermoelectric properties no change in the electromotive force is produced by altering the metals of those parts of the circuit that are at uniform temperature. Usually at the cold-junction end of the circuit, copper leads, brass binding posts, manganin resistance coils, and various other materials form part of the circuit, but so long as all are at a uniform temperature (or if for each junction between unlike metals there is a similar opposing junction at the same temperature) no resultant thermoelectromotive force will be produced thereby. Likewise, if a length of several inches at the hot-junction end of the couple is at uniform temperature, it matters not if this section is unlike other parts of the couple, so long as there is good metallic connection and no source of e.m.f. other than thermoelectric is present. Cutting off part of the hot end of the couple within such a region of uniform temperature would not alter the e.m.f. of the couple.

Changes in a couple originally homogeneous may be detected by making one calibration with the temperature gradient along a section of the couple that has been subjected to furnace conditions and another with the gradient along a section that has not been exposed to deteriorating conditions. The latter should be the same as the original calibration. If the alteration had taken place while the couple was in use at a given depth of immersion, a calibration in this position would be intermediate between calibrations made as above, since only part of the wires within the temperature gradient would have undergone the maximum change.

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\* Received Sept. 25, 1919.

### Experimental Data Obtained on Charpy Impact Machine

Discussion of the paper of F. C. Langenberg, presented at the Chicago Meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1471.

JOHN H. NELSON, Worcester, Mass.—At our plant we have done considerable work on notch-bar testing and are farther at sea now than when we started. So far, we have been unable to get the notch-bar test to be consistent with any other known test. Lately, I have been investigating the effect of the position of the notch-bar specimen in a bar. To do this I took a  $3\frac{1}{2}$  in. square bar and quartered it, then heat treated the four quarters. Each of these pieces was again quartered and a specimen machined and notched. In this way we would have notch-bar tests from the exterior to the interior of the bar. These were made of such lengths that it was possible to make four impact tests on each specimen.

Extreme care was taken in marking the position of these test specimens in the original bar. The notches were then cut with relation to position of the specimen in the original bar. The second notch was cut  $90^\circ$  from the first, and so on around the specimen. In this way, we have found that, with a  $3\frac{1}{2}$  in. bar of 0.4 or 0.5 per cent. carbon steel when properly heat treated, we could get impact values ranging from 15 to 100 ft.-lb. Just why this is the case we are unable to state; but it does appear to be a fact that along the outside of the original bar the notch-bar test seems to be low and increases toward the center, but it is not always consistent. For instance, we may have, on a single specimen, one notch-bar test giving us 15 ft.-lb. and another 100 ft.-lb.

We have not found such inconsistencies in alloy steels. Alloy steel is consistently good or consistently bad. If it is good, you cannot readily destroy the impact value, no matter what you do; if it is bad—that is, if it is a poor notch-bar steel—and you have sufficient latitude in your draw, you may correct it. In other words, if the hardness you are working to will allow you to draw to about  $1050^\circ$  F. ( $561^\circ$  C.) or over and then quench this steel from the draw heat, you can raise the impact value of the steel from about 4 or 10 ft.-lb. up to 40 or 50 ft.-lb. Just what occurs I do not know. There is evidently a critical point in steels that have poor impact value, in the neighborhood of  $1000^\circ$  F. to  $1050^\circ$  F. ( $536^\circ$  to  $561^\circ$  C.).

I have taken a number of coupons of chrome-nickel steel with low impact value and heat-treated as follows: Quenched all coupons in water from the same temperature, then varied the draw temperature on these coupons by  $50^\circ$  and water quenched each coupon from the draw heat. No increase in impact value was found until a drawing temperature of

between 1000° and 1050° F. was used, when the impact value of the steel was greatly increased over that obtained when the same draw temperature was used and air-cooled.

I have also taken the same steel, water-quenching this steel from the draw heat to produce good impact values, and then redrawing these coupons beginning with about 500° F. and varying the draw temperatures by 50°, and air-cooling them in every case to determine at what point the impact values would be reduced by air-cooling. This method again indicates that the critical point is somewhere in the neighborhood of 1000° to 1050° F. The unnotched impact tensile test bears absolutely no relation to the notched-bar test. By using an impact tensile specimen which is not notched, equally good results may be obtained on low notch-bar steel or a high notch-bar steel. There is no choice between the two.

We have adopted as an impact tensile specimen a diameter of about 0.235 in. and a 1 in. gage length. This will give results on elongations which are comparable with those obtained on the standard 0.505 diameter and 2 in. gage length. By using this specimen, we have found that better results on elongations and contractions may be obtained on the impact tensile test than upon the static tensile test.

We have been unable as yet to determine the exact meaning of the notch-bar test when used in comparison with the commonly accepted tests on steels. We are continuing to work on this most interesting subject and trust that sooner or later we may be able to determine the true meaning of the notch-bar test.

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### Chilean-mill Practice at Portland Mill

Discussion of the paper of LUTHER W. LENNOX, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2847.

R. B. T. KILIANI, Denver, Colo. (written discussion\*).—Mr. Lennox's paper is decidedly interesting in that he shows that a field exists for the Chilean mill, in which its efficiency compares favorably with that of more modern grinding devices. The figures he has given clearly indicate that a coarse feed is conducive to higher efficiency than the fine feeds which the Chilean mill has usually been called upon to grind. The fact is also apparently indicated that operating the Chilean mill in closed circuit with a mechanical classifier results in still higher efficiency, and that in such cases the percentage of returns should be kept below 100 per cent. to obtain best results. It would be interesting to see the results of further tests with what Mr. Lennox calls "Mixed Feed," since the data given in Table 4 seems to point to the fact that a mixed feed,

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\*Received Sept. 22, 1919.

with the mill in open circuit, may result in maximum efficiency for the Chilean mill, even higher than that obtained on a coarse feed and in closed circuit.

Mr. Lennox has mentioned the published data on tests between Chilean and Hardinge mills at the Miami Copper Co.'s plant several years ago, and has shown that the efficiency of the Chilean mill may be very materially increased over that obtained at that time. The developments in the use of the Hardinge mill at Miami have also been as great, since their present practice is grinding in conical ball mills in two stages, the last in closed circuit, from mill bin to pass 48-mesh. I realize, of course, the danger in trying to make comparisons between different machines operating at different plants, but the work done by Mr. Lennox on the "crushing resistance of various ores" gives a basis for such a comparison. I will show later that the constants derived by Mr. Lennox to represent the "grindability" of various ores can be so used.

The present practice at the Portland mill is to grind the coarse feed in Chilean mills equipped with 6-mesh screens, and operating in open circuit. Under these conditions, an average efficiency of 396 mesh-tons per horsepower is obtained, with a maximum of 413. As compared with this, an 8-ft. diameter Hardinge ball mill in open circuit (the first stage mentioned above) has an efficiency, corrected for the "grindability" of the ore, of 486 mesh-tons per horsepower. Operating the Chilean mill in closed circuit is conducive to higher efficiency, as already mentioned, than open circuit grinding. But even under these conditions of maximum efficiency for the Chilean mill, it can only show 418 (426) mesh-tons per horsepower.

Again, let us consider the tests on the Chilean mill in closed circuit, with a coarse feed, and with the finest grinding—or finest classifier overflow—mentioned in the paper. These are the two tests mentioned in Tables 5 and 7, with efficiencies of 328 and 377. Taking the average of these two tests, we obtain a final product containing 4.0 per cent. on 48-mesh and an efficiency of 353 mesh-tons per horsepower. As compared with this, one entire section of three Hardinge mills at Miami, grinding to 0.4 per cent. on 48-mesh, has an efficiency, corrected for "grindability" of the ore, of 457 mesh-tons per horsepower.

To summarize the above data, the following tabulation, giving efficiencies corrected for the character of the ore, is of interest:

| CHILDREN MILL HARDINGE MILL                     |     |     |
|---|-----|-----|
| Efficiency when grinding in open circuit.....   | 396 | 486 |
| Relative efficiency.....                        | 100 | 123 |
| Efficiency when grinding in closed circuit..... | 353 | 457 |
| Per cent. on 48-mesh.....                       | 4.0 | 0.4 |
| Relative efficiency.....                        | 100 | 129 |

The Miami Copper Co. and the Nevada Consolidated Copper Co.

are both using Hardinge mills of the same diameter for practically the same range of work, namely as secondary or regrinding machines. Two runs at Miami show an average efficiency of 478 mesh-tons per horsepower. This, when multiplied by the constant of 0.70 for the Miami ore, gives a corrected efficiency of 335. In a similar manner, five runs at Nevada Consolidated show an average efficiency of 556 mesh-tons per horsepower which, when multiplied by the constant of 0.61 for this ore, gives a corrected efficiency of 339. This is a remarkably close check, being within about 1 per cent. Other data on Hardinge mills at other plants only further bears out the correctness of Mr. Lennox's factors.

C. H. BENEDICT,\* Calumet, Mich.—At one plant we had 48 Chilean mills. At present 16 units are still so equipped, which we will probably continue to operate. The others have been replaced by another well-known type of mill. I am not here to act as spokesman for one mill or another, but I wish to point out, for the benefit of some who have not used Chilean mills, some of the possible difficulties that will be met. Of course, we were doing fine grinding, something that Mr. Lennox says these mills are not suited for. We attempted to grind  $\frac{3}{16}$ -in. material and we were aiming for as fine a product as we could get; we were actually obtaining about 35 per cent. through a 200-mesh, the ore being a very hard material to handle, and we found, as compared with other types of mills, that our lost time on the Chilean mills was very large. I think Mr. Lennox gives a figure approaching 4 per cent. as lost time. That would correspond fairly closely with our experience; in other words, one day a month. You who have used ball mills know that you can reduce that time to one day in five, six, or eight months.

Another thing that bothered us a great deal, inasmuch as we wished to grind very fine and did not grind in closed circuit, was the fact that we had a great deal of trouble with our screens, our Chilean mills would not grind alike two days in succession. That trouble increases as you attempt to grind the product finer; your screen must then be thinner and finer and accordingly you get an increasingly complex problem.

Conditions of this description led us to replace the Chilean mills in one of our plants with pebble mills; and the only reason that we do not replace the other 16 Chilean mills is simply because the space and conditions are such that it would be impossible for us to do so. I give this as our experience and not necessarily as any criticism.

G. M. TAYLOR,† Colorado Springs, Colo.—When we installed our Chilean mills at our Victor mills we expected to get about 150 tons a day; when the mills were installed we got about 90 tons in 24 hr. when feeding

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\* Metallurgist, Calumet & Hecla Mining Co.

† Manager, Milling Dept., Portland Gold Mining Co.

them with a  $\frac{3}{4}$ -in. material. I went away just at that time so the manager of our Colorado Springs plant, who was in charge, decided that if we fed a much finer mesh we would get a greater tonnage—which was a natural thing to assume. He therefore installed two additional sets of rolls and crushed everything through a  $\frac{1}{4}$ -in. mesh and the tonnage immediately dropped to 75 tons from 90. I returned about that time and put everything through a  $1\frac{1}{4}$ -in. screen, when the tonnage went up to 140 tons the next day.

### Investigations Concerning Oil-water Emulsion

Discussion of the paper of A. W. MCCOY, H. R. SHIDEL, and E. A. TRAGER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1513.

A. W. AMBROSE, Washington, D. C.—Did you make any analysis of the amount of emulsion at the well and after you flowed it through a lead line to the storage tank?

E. A. TRAGER.—B. S. can be formed in passing through a lead line by the friction due to the roughness of the pipe and the irregularities at the joints.

R. W. MOORE.—Did you find the percentage of water to be limited to the percentage of oil in the emulsion which formed?

E. A. TRAGER.—Yes, the percentage is about 67 per cent. water and 23 per cent. oil.

R. W. MOORE.—If you added more water would the emulsion be permanent?

E. A. TRAGER.—Yes, it would be permanent, but the excess water would separate out.

THE CHAIRMAN (C. W. WASHBURN, New York, N. Y.).—Did you use hot or cold water in these experiments?

E. A. TRAGER.—It makes no difference which is used. We tried to determine whether the composition of B. S. formed in the presence of excess water would differ from that formed in the presence of excess oil. The percentage composition in each case appears to be the same.

F. G. COTTRELL, Washington, D. C.—In electrical demulsification experiments in the West a number of years ago, we found no lower limit to the size of globules in an emulsion that could be dealt with, and I believe this has been borne out in the operation of the commercial plants that grew out of this work and are in operation today. I am therefore

surprised at the results that Mr. Trager has secured, and am inclined to think that he may not have applied the treatment in the same way, because it was with those very fine emulsions that we were working in our experiments.

E. A. TRAGER.—The chemical laboratory worked on this same subject and tried using a high voltage current to break down the emulsion, but the results were not commercially practical for it was found necessary to treat fine emulsions several times before they were completely broken down.

F. G. COTTRELL.—Do you know the details of the experiments—the voltages and conditions?

CHAIRMAN WASHBURNE.—I believe you used high voltages in your experiments did you not, and alternating current?

F. G. COTTRELL.—Yes.

CHAIRMAN WASHBURNE.—It seems to me, since there is no doubt that every globule must have its charge of static electricity, the smaller the globule, the easier it would be moved by electrical currents and discharges. The normal static charges will be of like kind and proportional to the surface area of the globules of oil which will vary with the square of the radius, while the volume to be moved will be proportional to the cube of the radius. It is very evident, from the consideration of squares versus cubes, that it must be easier to combine large drops than small ones, because the smaller they are, the easier it is for these little static charges to keep the globules from quite touching each other. These are all technical questions and of value in the manipulation of oil emulsions. In the geological sense, there can be no emulsion. In unlimited time, the globules must come together and coalesce into larger bodies, thereby destroying the emulsion.

E. A. TRAGER.—I had a discussion with Dr. Born (chief chemist) on the subject of electrical treatment of emulsions and the following are the conclusions arrived at: The smaller bubbles, as Mr. Washburne says, move toward the electrode with greater speed, and when two such bubbles collide or when these small bubbles strike the electrode, the tendency is rather to break down into even smaller bubbles than to coalesce. The larger bubbles apparently move more slowly and when two meet they coalesce quite readily.

F. G. COTTRELL.—There are two entirely distinct technical processes which are often confused with one another. One is the electrical precipitation of suspended particles out of a gas with a direct or at least unidirectional current, and the other is the demulsification of liquid

mixtures using an alternating current. The fundamental phenomena on which these are based are quite different as they are actually carried out.

In the first case, the suspended particle takes a charge by convection from one electrode, and then is driven over and deposited on the other electrode. In the case of the demulsification of the oil and water mixtures with the alternating current, however, there is no steady migration toward either electrode. The field is continually reversing so the only tendency is for the irregularly distributed globules of water to arrange themselves along the shortest lines between the electrodes. With a very fine emulsion, you may easily observe this through a microscope, the globules forming chains and gradually coalescing along these chains. In all probability, the apparent contact is not directly between the actual oil in the globules but is a contact of a film of impurities projected to the surface of the globules. With perfectly pure paraffine oil and water, it is very difficult, if not impossible, to make a reasonably permanent emulsion, but by adding a trace of some resin or similar substance to the oil, the emulsion becomes stable at once. In crude oils there are varying amounts of such material. Large drops tend to flow together and break through that film by the force of gravity. As the size of the globules decreases, a limit is reached where that force is no longer sufficient to press the globules together sufficiently to break through these films, but if the globules are polarized by being brought between the electrodes, it may be possible to puncture that film enough to make them coalesce. That is the picture of the process I have formed from watching it under the microscope and from the general action I have seen in the electric treaters. In the case of the demulsifying process, it is not a matter of electricity being actually discharged from one electrode to the globule, but of the water being a better conductor, and of the consequent tendency for water bubbles to arrange themselves in the oil along the shortest lines between the electrodes. This finally brings the globules into contact and causes their coalescence.

R. W. MOORE.—Did you use distilled water, and what type of oil?

E. A. TRAGER.—In these experiments we used ordinary tap water which comes from the river and contains considerable inorganic matter. The oil was Augusta crude.

R. W. MOORE.—Were any chemical means taken to bring down the emulsion, such as treating the emulsion with salts?

E. A. TRAGER.—We found nothing that would treat all types of emulsion and do it economically.

CHAIRMAN WASHBURN.—Were any of these experiments repeated with different oils? Sometimes one emulsified oil will act very differently from another, although both come from the same field.

E. A. TRAGER.—We used oil from eight or ten wells, but all the wells were in Kansas.

CHAIRMAN WASHBURNE.—Can you tell us anything about the chemical means of separating emulsions?

E. A. TRAGER.—I believe a process is now being used in Oklahoma that employs sodium salts and various other compounds (preparations similar to soft soap), but I do not know whether or not they are commercially successful.

R. W. MOORE.—Where the oil is emulsified in the water, heat under pressure is worked out very nicely in some of the European products, particularly in lubricating oil. There is a very rapid separation, so, if a man is treating lubricating oil under a heavy pressure, he can throw that in his tanks and get a very rapid separation by purely, we may say, mechanical and not chemical means.

CHAIRMAN WASHBURNE.—Is pressure an essential part in that operation?

R. W. MOORE.—I do not know. It is claimed that under ordinary conditions of heating they got no separation but with the oil and water emulsion under about 60 lb. pressure they did.

R. E. COLLOM,\* Washington, D. C. (written discussion†).—The writer disagrees with the definition and use of certain terms in the paper. The second paragraph says: "Laboratory investigations were conducted in an attempt to learn the composition and some of the properties of emulsified oil, or B. S., as it is more commonly called. . . . In this discussion we will limit the term B. S. to that heavy, dark-brown emulsion composed of a physical mixture of water, oil, and air with some included inert matter, either organic or inorganic."

The abbreviation B. S., in oil-field practice, is never properly applied to an emulsion. B. S. may contain some emulsion in the form of sludge, which is a mixture of mud—derived from clay or shale—and emulsified fluid. But B. S. means "bottom sediments" or "bottom settlings" and such sediments are entirely different and distinct from oil-water emulsions. Bottom sediments contain certain definite ingredients of oil-well production that have no commercial value. They include sand, mud, sludge, and other semisolid material. Oil-well emulsions, when properly treated by electric dehydrators or other means, give up certain quantities of valuable oil. The term B. S. certainly excludes the greater bulk of emulsions, which are nothing more or less than mechanical mixtures of oil and water. The writer prefers the use of the word "sludge," rather than the

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\* Petroleum Technologist, U. S. Bureau of Mines. † Received Oct. 22, 1919.

abbreviation B. S., for the particular physical mixture—in bottom sediments—containing emulsion.

Emulsified fluids vary in their combined proportions of oil and water. The gravities of the oil undoubtedly control the proportion of oil and water in emulsified mixtures. Light oil will carry less free water in suspension than heavy oil but an emulsion of light oil and water will show a higher water content than one of heavy oil and water. If the Baumé gravity of the pure oil in emulsion is known, a fairly close figure for the percentage of water in the emulsion may be determined in the following manner. Baumé gravities are proportional to volumes. The Baumé gravity of water is 10. The Baumé gravity of each fluid, multiplied by the respective percentage of volume of each fluid and divided by the sum of percentages of volume, or 1, equals the Baumé gravity of the emulsion. That is, where

$p$  = gravity of pure oil;

$w$  = gravity of water;

$e$  = gravity of emulsion;

$x$  = per cent volume of pure oil;

$y$  = per cent volume of water;

$$\frac{px + wy}{x + y} = e \quad x + y = 1.0 \quad x = 1 - y$$

$$p - py + wy = e \quad p - y(p - w) = e$$

$e$ ,  $p$ , and  $w$  are known, solve for  $y$ .

### Some Properties and Applications of Rolled Zinc Strip and Drawn Zinc Rod

Discussion of the paper of C. H. MATHEWSON, C. S. TREWIN, and W. H. FINKELDEY, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2775.

W. H. PORTH, New York, N.Y.—I would like to ask what effect segregation of lead would have upon the corrosion of sheet zinc; also what effect would abnormal percentages of iron have upon the ductility of sheet zinc? One of our difficulties seemed to be that the cells, when standing on the shelf, corroded. We have attributed this to local action in the zinc sheet. We would like to know whether the segregation of these impurities in this sheet zinc will have any effect on the local action occurring in sheet zinc. Lately we have had difficulty in punching some sheet zinc, in that the sheets split in the die. The section that split seemed to have an abnormally high percentage of cadmium and iron; would that cause it to become brittle?

C. H. MATHEWSON.—Iron is one of the most unwelcome impurities when high ductility is the principal requirement in rolled zinc. High

iron would certainly affect the drawing qualities adversely. Abnormally high percentages of cadmium localized in portions of the rolled sheet would probably produce hard spots and cause brittleness. I don't feel competent to definitely answer questions as to the corrosion of rolled zinc since we have not completed any very exhaustive series of tests along that line. In general, anything that tends to bring about local variations of concentration in metal is disadvantageous from the standpoint of corrosion, and I should regard pronounced segregation of lead as disadvantageous on general principles.

W. H. PORTH.—To us, that corrosion seemed to be more evident with sheet zinc that was of rather high purity than on zinc that was not so pure; that is, contained less lead.

F. G. BREYER, Palmerton, Pa.—May I ask, when you speak of corrosion, was that the result of a corrosion test?

W. H. PORTH.—No, it was not. We judge entirely by the shelf-life deterioration of a dry cell.

F. G. BREYER.—The trouble with the battery shelf deterioration is that there are so many other things that enter into it besides the metal itself. We should develop a satisfactory test that has fewer variables in it and which can be extrapolated to shelf life.

### **Mechanical Properties and Resistance to Corrosion of Rolled Light Alloys of Aluminum and Magnesium with Copper, Nickel, and Manganese**

Discussion of the paper of P. D. MERICA, R. G. WALTEBERG and A. N. FINN, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1051.

G. K. BURGESS,\* Washington, D. C.—In the service tests, the Advisory Committee on Aeronautics considered it highly necessary, particularly for seaplanes, to find out whether or not it was necessary to paint exposed parts; reports have been obtained but have not been published at the present time. Investigations were carried on at three Navy Yards. On just a hurried examination, the inspection was made about two weeks ago and the results are now being digested—an examination shows that the aluminum alloys, whether painted or unpainted, stand up very well. It apparently is not necessary to paint, which, of course, is a very important item in the question of the weight of seaplanes. We will be able to report on that, I expect, probably at the next meeting.

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\* Chief, Division of Metallurgy, U. S. Bureau of Standards.

### Pyrometer Porcelains and Refractories

Discussion of the paper of R. W. NEWCOMB, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1975.

A. O. ASHMAN, Palmerton, Pa. (written discussion\*).—Mr. Newcomb's paper has interested me greatly, as I have had numerous experiences along this line. I do not think enough emphasis can be put on his warning to keep platinum couples free from contact with quartz tubes, as silica shows a tendency to alloy with platinum to a surprising degree even at low temperatures. I have frequently had evidence of silica contamination in a perfectly good tube, in which there was seemingly no possibility of a reducing atmosphere.

This is rather important as it seems to be common practice to insulate, as well as protect, the wires by means of capillary silica tubing, thus allowing the entire wire to be in contact with the silica. The best way to mount a couple in a silica protecting tube is by means of double-bore porcelain insulating tubes, the protecting tube being slightly longer than the couple so as to leave a space between the couple and the end of the tube. In this way there is no possibility of contamination from silica. In no case should silica capillary tubes be used to insulate platinum wires.

Mr. Newcomb states that there is still much to be desired in pyrometer protecting tubes; this is in keeping with my experience. From a practical standpoint there is not a satisfactory pyrometer tube on the market for high temperatures; with all due respect to the many improvements and good work recently done in this line. I believe that the whole future development of pyrometry is dependent on the development of suitable refractories. With suitable refractories, for example, Darling's<sup>†</sup> work with liquid couples could be developed to a practical basis, making possible the use of base-metal couples to replace platinum.

CARLETON W. HUBBARD, Greenwich, Conn. (written discussion†). This paper would have been more valuable if the information in it had been tabulated, giving the author's recommendations for primary and secondary tubes for various temperature ranges and uses. The danger of thermoelement contamination is generally not sufficiently appreciated. This point is touched on several times in the paper, but the actual danger points as to temperatures and conditions of use are not given as elaborately as they should be to be of value to the purchaser or engineer, who, at the same time, is not a chemist. There is need for a definite body of infor-

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\* Received Sept. 25, 1919.

† Received Oct. 8, 1919.

<sup>1</sup> C. B. Darling: Base-metal Thermoelectric Pyrometers. *Jnl. Faraday Soc.*, Meeting Nov. 7, 1917.

mation regarding temperatures at which various kinds of tubes begin to deform. Some test standards for this kind of work should be set, and I would suggest various lengths of overhang for tubes of different diameters and wall thicknesses.

### Mill Operations at United Eastern During 1917 and 1918

Discussion of the paper of W. O. NORTH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1171.

G. M. TAYLOR,\* Colorado Springs, Colo.—The ore treated at the United Eastern is primarily a gold one and is cyanided—the counter-current decantation method being employed. One of our employees visited this plant a few months ago and, on his return, reported that the moisture in the tailing was carrying 20 c. per ton, which would appear to be somewhat high. As this type of plant has been advocated by one of the recognized cyaniding engineering firms in the country, and a number of these plants are in successful operation, it does not seem to me that the dissolved loss could be so high, and I would like to know if any one can give any definite information on this point?

J. V. N. DORR, New York, N. Y.—I am very glad that Mr. Taylor has raised this question. When I first read Mr. North's paper and saw his statement, that they had an actual dissolved loss of 21.5 c. per ton, I was very much puzzled at this high loss which appeared avoidable by another decantation or the addition of a rotary filter. Reading it again, however, I noted that the actual dissolved loss of 21.5 c. given was evidently obtained by multiplying the assay of solution discharged from Z thickener by the tonnage. On the basis of 283 tons milled per day, this means \$56.54 going to the dam. He states, however, that he returns from the dam into the system, 70 tons daily assaying 40 c. per ton or \$28 per day, so it would seem reasonable, unless I have overlooked something to regard the actual dissolved loss as \$56.54 less \$28 or \$28.54, equaling 10.8 c. per ton. Even this loss, however, is much higher than good practice elsewhere, and can be accounted for largely by the tonnage being handled, which I believe is 30 per cent. above the capacity planned.

The fact that all the thickeners but the last step discharge at about 52 per cent. moisture, instead of 45 per cent. as calculated originally, makes a great difference in the washing efficiency. The dissolution of 36 c. additional in the decantation system after the agitators have made all the extraction they can, has also contributed to raise the dissolved loss. It emphasizes, I think, the statement that has been made, that

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\* Manager, Milling Dept., Portland Gold Mining Co.

in many cases the additional amount dissolved in countercurrent decantation will more than pay the cost of operating and the entire dissolved loss, so that if instead of this system the agitators were followed by filters that removed 100 per cent. of the dissolved gold at no cost, the net earnings would be less than now.

L. D. MILLS, San Francisco, Calif.—I should like to ask Mr. Dorr if he can tell us, in referring to the diagram on page 1181, why the solution is returned to the tank marked X instead of corresponding to the usual practice and being returned to the tank marked Y.

J. V. N. DORR.—The addition of barren solution to X instead of to Y should theoretically reduce the mechanical loss of cyanide about 30 per cent. On the other hand, the diluting effect of the barren solution in tank Y is lost, and thus the dissolved loss in gold is higher. It is safe to assume that the management has studied the balance carefully and is using the barren solution where it will produce the best results. The return of the 40 c. solution from the dump to Z must have a bad effect on the dissolved loss, but must have been considered and it undoubtedly represents the best practice in recovering the gold with the equipment available.

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### Cooling Properties of Technical Quenching Liquids

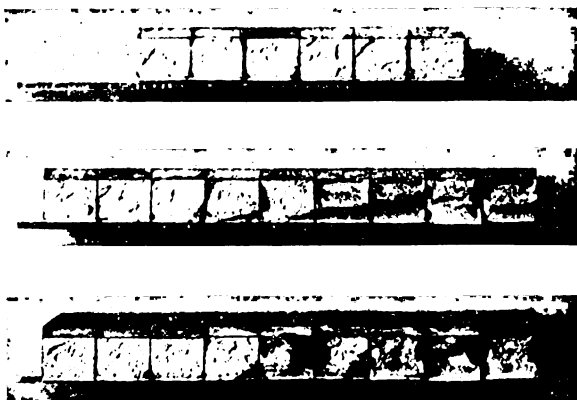
Discussion of the paper of N. B. PILLING and T. D. LYNCH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2347.

H. M. HOWE, Bedford Hills, N. Y.—One wonders whether it might not be well to check, by a rather simple and direct way, the inferences that would be drawn from this investigation. Suppose we quench in these various liquids cylinders of steel, selecting material that is not likely to split in hardening, and then examine their cross-sections microscopically. If the cylinder is of any size, you will find a series of concentric bands, a very hard band, a softer band, and a hard band—but it seems that here would be a way of checking the inferences from the cooling curves by comparing these waves of hardness obtained in similar specimens quenched in different liquids. One would think that there would be great promise in that way.

One's first thought is to quench similar pieces of steel, similarly heated, in different liquids and determine their hardness. I suppose many of us have tried that. We then meet the difficulty that it is not the most rapid cooling that gives the greatest hardness. There is an intermediate rate of cooling that gives maximum hardness so that you can not by any simple method as that check this cooling method. But it seems possible

that by studying these waves, by their amplitude, determining the distance you must go to reach a given hardness at the crest of the wave, you might infer the relative rapidity of cooling perhaps even more certainly than you could from the cooling curves themselves.

T. D. LYNCH.—After the paper was printed and in circulation we made some tests to show the idea brought out by Dr. Howe in his remarks. We selected a square bar of steel long enough to make 24 samples from the same bar suitable for Izod testing. The chemical analysis of the bar was: carbon, 0.58 per cent.; manganese, 0.38 per cent.; phosphorus, 0.009 per cent.; sulfur, 0.036 per cent.; silicon, 0.12 per cent. Nine of these samples were heated to 830° C. and quenched in water at temperatures, varying by 10°, from 20° to 100° C. The fractures of these test samples are shown at the bottom of Fig. 1, numbering from left to right: No. 1, 20° C.; No. 2, 30° C.; up to No. 9 which was quenched in water at 100° C. The change in the character of the fracture above 60° C. is very marked. Nine samples were heated to 830° C. and quenched in



a saturated solution of brine. These are shown in the middle of Fig. 1, beginning at the right with the brine at 20° C. and ending at the left with the brine at 100° C. The change of grain structure takes place at about the same place as that shown by the water. Two samples were quenched in oil at 25° C., two at 70° C., and two were not quenched at all. These fractures are shown at the top of Fig. 1. Beginning at the left, the first two were unquenched, the second two were quenched at 25° C.; and the third two, at 70° C. The fractures caused by the quenching in oil at 25° C. and 70° C. are very similar.

These tests show very clearly that the grain structure of the specimens was affected much more with cold water or brine than with hot water or hot brine and that the temperature of the quenching oil does not seriously affect the grain structure. They also show that the effect of the cold

water and cold brine is more drastic than oil at any temperature; that hot water or hot brine may be so controlled as to give practically the same, or less, effect than that of oil as a quenching medium; and that hot water and hot brine give a less drastic treatment than oil at any temperature.

RALPH M. SHERRY,\* Detroit, Mich.—One item has been omitted in some of these papers; that is the speed of the quenching medium or the volume applied. With a large volume of oil it is possible to obtain the same results as with water. It seems to me that in conducting work of this kind some attention should be paid to that factor. From years of practical experience, I know that perfect results can be obtained with oil if it is given a high rate of speed and I wonder if there has been any work done on this that may be brought out in discussion.

T. D. LYNCH.—These tests were made without agitating the oil or the water, which we believe is the most common practice, especially in the case of large forgings, and, while it is possible to quench steel parts in a moving liquid or by moving them through the liquid, these tests were carried out with the idea of having them represent common practice rather than possibilities. I appreciate fully the fact that flowing oil makes a decided increase in the quenching value of oil; rapidly moving air also has a marked difference on the cooling of a piece of steel in the air. We have found from experience that if you cool a piece of steel quickly by passing a strong current of air over it, you will get a true elastic limit perhaps double that of a similar piece of steel cooled slowly in the furnace and I have found in some of our work that it has been possible to double the elastic limit, raise the tensile strength considerably, and, at the same time, increase the ductility. These are possibilities which may bear some fruit in commercial work as time goes on.

R. M. SHERRY.—In our practice it is essential to assure a large flow of moving liquids. It is impossible to harden them according to specifications without an extreme flow of water or by quenching vertically in the tank. In ordinary commercial practice, it is absolutely essential to distinguish between moving liquids and still liquids.

THE CHAIRMAN (J. A. MATHEWS, Syracuse, N. Y.).—One point that has not been touched upon is the permanence of quenching mediums. How long can they be used without suffering deterioration? That must be looked after very carefully in quenching oils, uniform results cannot be obtained with oils that deteriorate with repeated use. Another point is the necessity of going very slowly in adopting conclusions from papers of this kind without considering the different steels and their capacity

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\* Chief Metallurgist, General Motors Corpn.

for being hardened. The speed of quenching is one thing and the capacity for hardening is quite a different thing, so while the oil or liquid might be perfectly satisfactory for one kind of steel, it may not be adapted to some other steel of different composition and different capacity for hardening.

NORMAN B. PILLING.—We are quite aware of the limitations of the paper, which are discussed in its introductory paragraphs. With respect to moving liquids, it is quite obvious that the effect is simply the tearing away of the vapor jacket surrounding the cooling body, resulting in the forced extrapolation of the zone of rapid cooling (the B stage) to temperatures higher than that at which it normally exists.

In regard to Dr. Howe's suggestion that another line of attack would be furnished by a microscopic examination of steel pieces quenched under various conditions, it is apparent that pieces of considerable size would be required, necessitating a quantitative knowledge of the internal temperature gradients during quenching. We find that in a steel cylinder of the dimensions of a lead pencil the microstructure transversely is quite uniform, except at the critical cooling speed of the steel when small differences in cooling velocity exert a relatively large effect on the completeness of martensitization. In this case the proportion of martensite to troostite does change in a radial direction.

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### Self-checking Galvanometer Pyrometer

Discussion of the paper of H. F. PORTER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1803.

PAUL D. FOOTE AND T. R. HARRISON, Washington, D. C. (written discussion\*).—There are several methods for measuring the internal resistance of a battery, the line resistance in a circuit containing an e.m.f., or the true value of this e.m.f. The writers, however, were the first to employ a simple principle whereby the total resistance of the circuit is adjusted to a preassigned value for which the scale of the millivoltmeter is graduated, the only e.m.f. employed being that of the source measured. One of the simplest forms of these instruments is described on page 2842, September *Bulletin*. In papers now in the press we have described some twenty modifications of this simple design but all operating upon the same fundamentally new principle. The instrument devised by Mr. Porter is of this general type but, unlike the designs we have recommended, is open to serious objections.

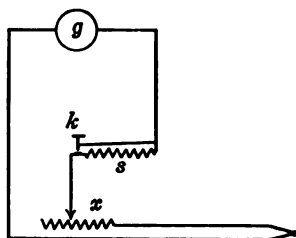
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\* Received Sept. 25, 1919.

If the e.m.f. of the source being measured is equivalent to the full-scale range of Mr. Porter's instrument, the adjustments can be made only if by chance the external resistance  $x$  equals  $s - g$ . Suppose that the full-scale deflection corresponds to  $e$  millivolts; the current required to produce this deflection is  $i = e/s$ . In the first adjustment, however, the current  $i' = e/(x + g)$ . Since  $x + g = a$  by the second adjustment, and since in general  $a < s = a + b$ , the current  $i'$  is larger than  $i$  in the ratio  $s/(x + g)$ . To keep the pointer on the scale throughout adjustment, therefore, the e.m.f. to be measured must not exceed the fraction  $(x + g)/s$  of the full-scale deflection. When  $x$  is reduced until it equals  $\frac{1}{2}s - g$  (i.e., when  $a = \frac{1}{2}s$ ) we have  $x + g = \frac{1}{2}s$  so that  $(x + g)/s$  equals  $\frac{1}{2}$ , hence only one-half of the scale e.m.f. can be used for adjusting the resistances. With couple and leads of zero resistance, the maximum e.m.f. for which adjustment can be made is  $g/s$  times the full scale e.m.f. which may or may not be less than one-half of the scale range of the instrument, depending on the characteristics of the individual instrument.

Since the ratio of maximum deflection to actual e.m.f. is  $(x + g)/s$ , the ratio of the half deflection to actual e.m.f. is  $2(x + g)/s$ , and an error in adjustment to the half deflection will appear in the final reading multiplied by this factor, which ranges from 2, where  $x = s - g$ , to  $2g/s$  as a minimum.

A more satisfactory arrangement, which utilizes the full scale, is illustrated by the accompanying illustration. The normal operating



position is with the key  $k$  closed. The current flowing in this case is  $i = e/(x + g)$ . With the key open the resistance  $x$  is adjusted until the deflection is halved; viz.,  $i/2 = e/(x + g + s)$ . Hence  $x + g = s$ , for which resistance the scale of the instrument is graduated. With this arrangement, adjustment can always be made with full-scale e.m.f. Obviously the ratio of deflections may be other than  $\frac{1}{2}$ . In some instances it may be of advantage to use a ratio 0.9, in which case a double scale could be employed, one scale graduated in intervals 0.9 as great as the other scale. Another disadvantage of Mr. Porter's instrument, as described, is that an e.m.f. or linear scale must be employed,

since proper adjustment could not be obtained by halving the deflection on a temperature scale. Furthermore, the instrument must be set to read zero on open circuit, which prohibits the usual cold-junction adjustment. These, and other, objections are successfully met in the instruments described by us in the paper just referred to, and furthermore, high sensitivity in adjustment is assured.

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### Temperature of a Burning Cigar

Discussion of the paper of T. S. SLIGH, JR., and H. R. KRAYBILL, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2241.

W. P. WHITE,\* Washington, D. C. (written discussion†).—The authors seem to have proved that for a phenomenon as irregular as the one they were investigating there was no perceptible conduction effect in the platinum wire. It should be mentioned, however, that the conduction of heat to and from small wires is not proportional to their surface and might give unexpected values, varying largely with the medium in which the wire was situated. Attempts to eliminate a conduction effect in the wire by extrapolating the curve obtained by using different sizes have in some cases given incorrect results, so that the authors' result should be applied with great care as a guide in other cases. The difference in size of wire employed by them is really rather small. If the desire had been to find out how great the effect was instead of merely to demonstrate its absence, a greater difference of diameter would, of course, have been selected.

The sharp gradient immediately in front of the burning portion of the cigar is quite surprising at first sight. The weight of air coming from a flame is considerably greater than the weight of material burned, and it would be thought that this stream of heated air would heat very considerably the material not yet reached by the zone of combustion. Possibly the heat is exhausted in evaporating moisture from the material. In that case the cigar is really a sort of regenerative furnace, except that it is not air but the material which is preheated, and the preheating produces dryness rather than increase of temperature. Whether or not this is the case would be shown by finding how hot a thoroughly dry cigar would get.

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\* Physicist, Geophysical Laboratory.

† Received Sept. 25, 1919.

### Influence of Heat Treatment on Gun Metal

Discussion of the paper of C. F. SMART, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1875.

R. F. WOOD,\* Sandusky, Ohio.—I made a few tests of gun-metal specimens, after I noticed the results on quenching reported by the Bureau of Standards. The data of one such test are given herewith. The bars were heat treated and quenched before they were machined, and in all cases they were brought up to 700° or 800°. They became extremely brittle, showed almost no elongation, except such as was caused by the failure of the pieces to fit together after they were pulled, and the tensile strength was reduced from around 35,000 to about 13,000 lb. per sq. in. In addition, the weakening effect of the quenching seemed to be almost as marked when the bar was allowed to slowly air-cool from red to black, and then quenched, as it was by quenching directly from the red heat.

*Test Bars.*—Rough size,  $\frac{9}{16}$  in. diam. over test section, grips  $1\frac{3}{16}$  in. diam. Cast two in a flask, one on each side of a block 8 by 4 by 1 in. and fin-gated thereto from the grips but not from the test section. Poured with flask in inclined position, with gate to lower end of block and riser from upper end of each test bar. Bars were machined to  $\frac{1}{2}$  in. over the test section, after heat treatment.

*Casting the Bars.*—Charge of 1500 lb. consisting of 400 lb. of new metals and 1100 lb. of G turnings and scrap was melted in open-flame oil furnaces and then poured into a 1-ton ladle. From the ladle 150 lb. was poured into a preheated No. 50 crucible, and from this the flasks of test bars were poured. The six flasks are indicated below by the numbers 1 to 6 and the bars in each flask by the letters a and b, thus 4a and 4b, for instance, were the two bars in flask No. 4.

*Heating the Bars.*—In all cases the bars were introduced into an already hot electric muffle and brought up to a temperature of about 800°, less rather than more, as gaged by a Leeds & Northrup optical pyrometer. The cooling was then commenced at once without the bars remaining at the attained heat. Two pairs of bars were heated at a time; groups D and G were heated together in the furnace, groups E and F together, and group C by itself. It will be observed that the pairing off by flask numbers and group numbers was so arranged as to reduce the chance of wrong deductions, such as might arise from abnormal conditions in any one flask of bars or in any one muffle load during heat treatment.

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\* Metallurgist, Sandusky Foundry & Machine Co.

| Group | Heat Treatment  | Bar | Ultimate Strength, Lb. per Sq. In.  | Yield Point, Lb. per Sq. In. | Elongation, Per Cent. in 2 In. |
|-------|---|-----|-------------------------------------|------------------------------|--------------------------------|
| B     | No heat treatment whatever  | 1a  | 35,900                              | 21,150                       | 15.0                           |
|       |   | 2a  | 36,400                              | 23,000                       | 17.0                           |
| C     | To 800° (10 min.*); cooled slowly in furnace (over 7 hr.)                               | 3a  | 37,750                              | 23,250                       | 28.5                           |
|       |   | 4a  | 35,800                              | 20,300                       | 25.0                           |
| D     | To 800° (20 min.); cooled in air (35 min.)  | 1b  | 36,200                              | 22,850                       | 21.5†                          |
|       |   | 5a  | 36,100                              | 22,000                       | 22.5†                          |
| E     | To 800° (25 min.); cooled to nearly black in furnace (25 min.); then in air (30 min.)   | 4b  | 30,900                              | 21,450                       | 17.5                           |
|       |   | 6a  | 38,500                              | 22,050                       | 26.0†                          |
| F     | To 800° (25 min.); cooled to nearly black in furnace (25 min.); then quenched in water. | 2b  | (Broke to pieces in lathe)<br>7,500 |                              | 2.5                            |
|       |   | 5b  |                                     |                              |                                |
| G     | To 800° (20 min.); quenched in water immediately.                                       | 3b  | 13,100                              |                              | 1.0†                           |
|       |   | 6b  | 14,500                              |                              | 4.0                            |

\* Time given in parentheses refers to time required for operation mentioned.

† Broke outside of gauge length.

P. E. MCKINNEY,\* Washington, D. C.—The question of heat treating red bronzes is of great importance to the foundryman who is producing any quantity of red bronze castings. The data and the information we have on heat treating and on annealing are only elementary. The effects of slow cooling from the molten state, in the case of heavy cross-sections can practically be eliminated and remarkable increases in strength and ductility obtained by the annealing or the heat-treating process. The strain cracks referred to probably have been encountered by others, but castings containing them have generally been ruined before an attempt to heat treat them is made. In other words, the pouring temperature was too high, or the strains due to the large segregations of enriched eutectic caused intercrystalline cracks or parting in the metal. Conditions like that cannot be corrected by heat treating any more than a steel forging or a steel casting can be welded by heat treating. If the crack or the opening is there, it remains there.

It has been quite noticeable, in our experiments in heat treating red-bronze castings, that the quench is really necessary to get the very best

\* Chemist and Metallurgist, U. S. Naval Gun Factory.

results in the case of a heavy cross-section, for the reason that the alpha constituent in a heavy section, slowly cooled, grows to very large grain size. The quench corrects this and, if followed by an anneal at a lower temperature, draws the strain out of the casting, frees the casting of enlarged grains of the alpha constituent, and the eutectic, in which the constituent has frozen out, is again divided into very fine grains and uniform structure with considerable increase in strength and ductility.

W. M. CORSE, Mansfield, Ohio.—Mr. McKinney, in quenching castings such as you have just mentioned, is there danger from actually cracking those castings during the quenching operation?

P. E. MCKINNEY.—There is considerable danger, especially if the castings are large; not so much from the effect of the quenching medium as from the handling of heavy sections. At approximately red heat, red bronze is one of the most tender metals. A piece of 88-10-2 bronze hit, when hot, a slight blow with a baseball bat will fly to pieces; that is, it will crumble. These castings must be handled very carefully. Some castings, in the shape of tubes, weighing about 3000 lb. could be handled only by putting them into a pit, suspended on a crane, and then picking them up and throwing a spray of water around them. It did not seem that the dipping in the water or the effect of the water was as bad as the sudden strain of picking them out of the furnace with a peel and handling them when immersing into the quenching medium. Oil seems to give no different results than water; so it is hardly a case of the effect of cracking due to sudden change of temperature.

W. M. CORSE.—There seems to be hot shortness in the casting itself.

P. E. MCKINNEY.—Yes; the casting will not stand the strain of its own weight if handled at those high temperatures. We would not think of removing a casting from the sand at the temperature that you would pick it up and quench it.

W. M. CORSE.—Do you believe it is possible to handle the casting so that the desired results may be obtained?

P. E. MCKINNEY.—Only by the same methods that you would use in handling forgings and big pieces of steel in quenching. We heat the casting in a vertical furnace so that the crane picks it up and, practically without any jarring, carries it to the quenching pit.

### Grain Growth in Alpha Brass

Discussion of the paper of F. G. SMITH, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 152, August, 1919, p. 1361.

F. G. SMITH.—Probably someone will ask whether I discovered why the bottoms of the large shells broke out. I did not, as a result of this investigation.

An experiment was made along the lines indicated in this paper, to determine whether abnormal grains greatly affected the physical properties of brass. Two ordinary test bars were annealed for  $\frac{1}{2}$  hr. at  $750^{\circ}$  C. and physical properties determined on one. The other was covered with indentations made with a peen hammer and then reannealed for 5 hr. at  $750^{\circ}$  C. It was found in the tensile test to be made up of large grains  $\frac{1}{4}$  to  $\frac{1}{2}$  in. in diameter. The physical properties, however, differed from those of the first bar only as much as might be expected after a 5 hr. anneal under normal conditions. It appears then that the large grains produced in this manner do not ruin the physical qualities of the brass.

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### Physical Properties of Certain Lead-zinc Bronzes

Discussion of the paper of H. F. STALEY and C. P. KARR, presented at the Chicago and Philadelphia meetings, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2513.

W. M. CORSE, Mansfield, Ohio.—Outside of the commercial valuation of the material, for what purpose does this alloy—90 per cent. of copper,  $6\frac{1}{2}$  per cent. tin, 2 per cent. zinc, and  $1\frac{1}{2}$  per cent. lead—seem to be eminently fitted?

C. P. KARR.—So far as our tests go, it would be eminently fitted for steam valves and pistons, and for the work for which 88-10-2 bronze is generally used, although for very large castings it would not be superior to 88-8-4 bronze.

P. E. MCKINNEY,\* Washington, D. C.—Some time back, due to a desire to avoid some of the objectionable features of 88-10-2 bronze, particularly on heavy castings, also to save tin where possible, we took up the question of a substitute for 88-10-2 bronze, where red bronze was ordinarily specified. After trying most of the mixtures, we found that when using as low a tin content as is given in this proposed composi-

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\* Chemist and Metallurgist, U. S. Naval Gun Factory.

tion, one very valuable property of general red-bronze casting construction is sacrificed; namely, its excellent bearing properties and rigidity. In other words, the material has a lower Brinell hardness than either the 88-10-2 or the 88-8-4 bronze, and when used as a bearing (of course, we are not speaking of even 88-10-2 as a bearing metal for extreme service) there is a tendency on the part of the softer alloys to pick up. On the other hand, the 88-8-4 bronze gives practically the same Brinell hardness as the 88-10-2 and has sufficient bearing properties and superior water-tight properties in castings of anything but very thin cross-section; that is, a heavy casting of any kind, when made from a carefully prepared alloy of 88-8-4 is probably an ideal water-tight casting, particularly if a little lead is introduced to close the grain. The effort to reduce the tin content in the casting is very necessary. Even this 6 per cent. of tin would be far superior, because there is no excess of tin to form a beta constituent.

It would be a good proposition if everybody interested in the use of red bronzes would conduct experiments, from time to time, with the introduction of nickel. Nickel seems to have some excellent properties. With a reduction of the tin and letting the zinc remain low, nickel seems to toughen the bronze; in addition to tin, it gives a very desirable combination of toughness and hardness. At this time there is a very good commercial reason for considering the use of nickel in the red alloys. As a result of the war, there is a lot of material that would be perfectly good casting copper if it were not contaminated with nickel, due to the manufacture of rotating bands for shells of various calibers. The utilization of these cupro-nickel alloys, that is, alloys containing from 1 to 3 per cent. of nickel, would offer a very economical method of introducing copper into these alloys.

I feel that this question should be taken up by foundries producing heavy castings, because while results obtained from test bars are extremely valuable and show what can be obtained under standard conditions, you cannot get the same results in a heavy casting that you can in the small casting made in a miniature cross-section.

R. F. WOOD,\* Sandusky, Ohio.—Mr. Karr's alloy B is very similar to an alloy that I have used for the past couple of years with 1 per cent. nickel substituted for 1 per cent. of the copper, and in making castings of about 3000 lb. weight it has given very good results in producing water-tight castings.

C. P. KARR.—Have you made any test bars of the metal in question, and if so, will you give us the results?

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\* Metallurgist, Sandusky Foundry & Machine Co.

R. F. WOOD.—I have a much less complete set of results than I wish I had, but in regard to its water-tightness I can say that it worked very nicely. The following shows some typical results.

| Weight of Casting | Ultimate Strength, Lb. per Sq. In. | Yield Point, Lb. per Sq. In. | Elongation in 2 In., Per Cent. | Copper, Per Cent. | Tin, Per Cent. | Lead, Per Cent. | Zinc and Nickel, Per Cent. by Difference |
|-------------------|------------------------------------|------------------------------|--------------------------------|-------------------|----------------|-----------------|--|
| 1000              | { 44,600<br>32,100                 | { 17,400<br>25,000           | { 28.0<br>5.0                  | 89.30             | 6.59           | 1.72            | 2.39                                     |
| 4020              | { 41,100<br>42,500                 | { 24,900<br>25,000           | { 21.0<br>25.0                 | 87.41             | 7.10           | 1.55            | 3.94                                     |

The second tensile test broke outside the gage marks.

C. P. KARR.—What hydraulic pressure was used?

R. F. WOOD.—These castings were  $\frac{1}{2}$  in. thick, were tested to 150 lb. without backing, and carried about 2000 or 3000 lb. pressure, backed.

### Potentiometers for Thermoelement Work

Discussion of the paper of W. P. WHITE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1763.

T. R. HARRISON, Washington, D. C. (written discussion\*).—Advantage will be taken of this occasion to mention briefly a form of double potentiometer which has been used at the Bureau of Standards for about  $2\frac{1}{2}$  yr. in calibrating thermocouples. The calibrations referred to are those made by comparison to standard couples.

In order to insure equality of temperature between the couples, the junctions are fused together; consideration of fundamental principles will show that this introduces no error. Two separate potentiometers are used, one connected to each thermocouple, and each potentiometer is provided with a reflecting galvanometer. The two spots of light are reflected on to a single scale, the galvanometers being set in such a position that the spots coincide on the scale at a point marked zero when the circuits are open or when the potentiometers are balanced. By setting one potentiometer to a desired value and adjusting the other so that both spots pass across the scale together as the temperature rises or falls, simultaneous readings are obtained.

By making observations first with a rising temperature and then with a falling temperature, the rates of rise and fall being approximately equal, and taking the means of the results found, several minor errors such as those due to differences in the time lags of the two systems, etc., are eliminated or greatly reduced. The differences between the values

\* Received Sept. 25, 1919.

observed with rising and falling temperatures are usually less than  $1^{\circ}$  with rare-metal couples. By this method a calibration may be made rapidly and with accuracy, since the junctions are fused together and means are provided for taking simultaneous readings on the couples while the temperature is changing.

On account of the fact that the junctions of the couples are in electrical contact and the readings must be made simultaneously, it is necessary to use potentiometers having entirely independent circuits.

LEASON H. ADAMS,\* Washington, D. C. (written discussion†).—For precision work with thermocouples in the laboratory, all are agreed on the necessity of using a potentiometer in connection with a reflecting galvanometer; but in the choice of an instrument for the factory, opinions seem to differ. Doctor White has discussed the advantages and disadvantages of three classes of portable instruments: the direct-reading millivoltmeter, the portable potentiometer, and the class to which belong the pyrovoltmeter and the heat-meter. My experience with pyrometer installations in the factory has led me to prefer the portable potentiometer and to consider that in accuracy, convenience, and reliability it is far superior to the other instruments. The fact that this potentiometer requires a battery and a standard cell has not proved to be a drawback, since they are built into the case of the instrument and require very little attention. Moreover, no difficulty has been experienced in teaching unskilled laborers to make accurate readings with the portable potentiometer, a few minutes' instruction being sufficient in all cases. The portable potentiometer has also proved to be very convenient for use in the laboratory when the extreme accuracy of the precision potentiometer is not required.

### High-temperature Thermometers

Discussion of the paper of R. M. WILHELM, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1687.

A. O. ASHMAN, Palmerton, Pa. (written discussion‡).—Owing to the conflict of the terms thermometry and pyrometry, in numerous cases the entire field of temperature measurements has been divided under these two headings. This confusion is probably due to the fact that originally a pyrometer was understood to be an instrument for measuring temperatures above the range of a mercury thermometer. In modern practice, however, pyrometers are not only used to measure the temperature over the range of the thermometer, but also to a much

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\* Physical Chemist, Geophysical Laboratory.

† Received Sept. 25, 1919.

‡ Received Sept. 25, 1919.

lower temperature, thereby eliminating the basis of the earlier division. It seems that the modern meaning of the term pyrometry is understood to include the entire field of temperature measurements, of which thermometry is one subdivision. The fact that this paper is presented at a pyrometer symposium would bear out this fact.

The following, I believe, gives the modern idea of the divisions of pyrometry, and shows the relation of thermometry to pyrometry:

- |                                    |                                     |
|------------------------------------|-------------------------------------|
| 1. Expansion pyrometry:            | 4. Optical pyrometry                |
| (a) Expansion of gases,            | 5. Radiation pyrometry              |
| (b) Expansion of liquids,          | 6. Calorimetric pyrometry           |
| (c) Expansion of solids.           | 7. Melting point pyrometry          |
| 2. Thermoelectric pyrometry        | 8. Transpiration pyrometry          |
| 3. Electrical resistance pyrometry | 9. Miscellaneous pyrometric methods |

### Physical Examination Previous to Employment

Discussion of the paper of C. F. WILLIS, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1013.

THE CHAIRMAN (F. K. COPELAND, \* Chicago, Ill.).—This is an interesting and very troublesome proposition to all of us. Ten or fifteen years ago, when the old-fashioned idea prevailed that a man was responsible for his own health and safety, that if anything happened to him it was his own lookout, we got along without this problem; but with the advent of accident compensation, with the agitation that there is all the time for pensions, sick benefits, and the responsibility of a company for the health of its employees, whenever you take a man on, that phase is becoming more and more important. One cannot afford to hire a man who is blind in one eye, even though he may have perfect sight in the other eye; if he loses that one eye, if he becomes a total disability, the company is liable for the man's complete sight.

Another thing that should make us particularly interested in this problem is the fact that the unions are very much opposed to it. One of the requirements of this steel unpleasantness is that the companies abandon their physical examination of employees. It is a very difficult problem to examine 400 or 500 men as intelligently as possible and decide whether a man on this or that side of the line is accepted.

T. T. READ, Washington, D. C.—The United States Bureau of Mines has in progress at the present time a study of the effect of underground atmospheric conditions on the safety and health of the workers. Improved methods have been employed and it is an excellent and extremely valuable piece of research work.

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\* President, Sullivan Machinery Co.

It is a distinct disadvantage that, with the present compensation laws, the crippled man is penalized because of the fact that he has lost one leg. If he loses the other he then becomes totally incapacitated and his employers will be correspondingly responsible, therefore no company cares to employ him. He must receive his total disability compensation if he loses the other leg, which he is more likely to do than the man who has two legs with which to get out of the way. This problem has been discussed with the organizations that have charge of the vocational re-education of returned soldiers and they are taking steps to adjust the matter.

I would like to ask if any one knows what is the real cause of opposition by labor organizations to physical examination, aside from the general policy of labor to fight anything of a compulsory nature? The arguments put forth by Mr. Gompers have very little basis of fact to rest upon.

CHAIRMAN COPELAND.—I have never been able to get any real light on the subject except the general theory that all men are equal and entitled to the same wage, and that if a man is a cripple he is discriminated against. I think the same difficulty has been found in the application of the minimum wage. A minimum wage is being established by some of the states, Massachusetts for instance, particularly in the employment of women. As the employer has got to protect himself against the employment of inefficients, instead of employing a man or woman and paying what each can earn, the question at once becomes, can the applicant earn the minimum wage which tends to throw a lot of people out of employment? It is not always easy to know why these things are opposed, but I have worked that theory out in my mind.

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### Educational Methods at the Copper Queen

Discussion of the paper of C. F. WILLIS, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1099.

G. M. TAYLOR,\* Colorado Springs, Colo.—I do not think the plan outlined in this paper would work at Cripple Creek. Most of our men have had a pretty good education. The Cripple Creek district is a lessee district—I do not think there is one mine operating in Cripple Creek to-day that does not have the leasing system. We have as many men leasing on our property as we have mining and every man who is working for wages is looking for a lease—every man has mined for himself, he has been his own boss on a lease, either on our own property or on some of the other properties, and it makes a different class of employees.

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\* Manager Milling Dept., Portland Gold Mining Co.

THE CHAIRMAN (F. K. COPELAND, \* Chicago, Ill.).—Do you have much labor turnover?

G. M. TAYLOR.—No, we do not. We are very short of men.

CHAIRMAN COPELAND.—What has been your experience during the last two or three years, have the men been coming and going?

G. M. TAYLOR.—No, they have not. When the war broke out quite a number of our men went to the copper mines; 50 per cent. of them returned. They came back to lease and most of them took leases. Our labor turnover is practically nothing.

CHAIRMAN COPELAND.—You have been very fortunate. I have known cases where it has been as high as 80 per cent. If educational effort like this can give the men an added interest in their work and an added incentive and create the feeling among them that the employer is interested in their progress and is anxious to give them an opportunity to improve their positions, I think that it is a most valuable thing. So many men, in mining and other industries, simply have the day's work before them and it is just a question of getting a day's work done as well as possible for a day's wages. That, I think, tends to crowd them into organized labor, I. W. W., or whatever it may be, so that any employer, in any line, who can make his men feel that he is coöperating with them, that they are a part of the organization, is doing valuable work toward solving some of the problems that confront us.

I was quite interested this past winter in an effort we made toward the education of foreigners. We employ many French, some Poles, and some Russians and started a night school, which after a while we opened to the women—the wives of the foreigners. The attendance was so gratifying that we opened it to all the town. It was entirely voluntary and free. This was not along the line of technical education but of the general education of foreigners. It is very satisfying to see their interest, and the regularity with which they attend, and the progress they make.

C. H. BENEDICT, † Calumet, Mich.—We have good public schools with night sessions which are fairly well attended, but the pupils are almost entirely Americans rather than foreigners.

CHAIRMAN COPELAND.—I think that is unfortunate, because, unless a man can read and speak the English language, it is very hard to get at him, and I think we all ought to get back of this Americanization movement and push it.

T. T. READ, Washington, D. C.—The fact should be kept in mind that Mr. Willis is discussing vocational education and not training in English,

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\* President, Sullivan Machinery Co.

† Metallurgist, Calumet & Hecla Mining Co.

which is now more commonly spoken of as "Americanization." Mr. Willis does not make any mention of the fact, but it should be noted here, that there is a Board of Vocational Education which has a large appropriation for that work. While we have not seen any visible results of its efforts yet, this Board has a good organization and will, undoubtedly, in time do good vocational educational work, so that its coöperation will be valued in years to come. A number of courses in mining have been prepared by competent men for criticism.

Other things being equal, better results are obtained with a capable teacher who is not familiar with practice than with a practical man who does not know how to teach. Some firms have used for this purpose teachers who are volunteers; young men who are willing to give their time, just the way people give their time to teaching in Sunday School. That plan usually does not work well, and if the job is worth doing at all it is worth paying for, even though the pay may be small. You get much better results in the end. Some firms that have given vocational training, to insure that the men would complete the course, have made all persons pay a small sum at the beginning of the course, which is returned to them on a basis of the number of sessions attended so that if a man quits half way through the course, he loses half his money.

It must always be remembered that you must adapt your methods to the class of men you are dealing with; you have got to adapt and develop your system for your own peculiar circumstances.

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### Method of Curtailing Forces at the Copper Queen

Discussion of the paper of C. F. WILLIS, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2229.

THE CHAIRMAN (F. K. COPELAND,\* Chicago, Ill.).—At this particular time conditions existing in this country, and elsewhere, make all questions of milling or smelting or mining, or anything else, absolutely secondary to the one question of labor. We have always devoted our attention largely to the efficiency of machinery, and to reductions in costs, etc., and have let this tremendous problem of our relation to labor more or less take its own chances. There has never been a time when those who are responsible for the operation of business of different kinds were as completely at a loss as they are now, so that anything that can be brought out that relates to labor is, to my mind, of utmost importance.

T. T. READ, Washington, D. C.—This formulation of a method of curtailing forces at the Copper Queen is a notable step in advance of our treatment of personnel in the mining industry. So far as I know, it is the

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\* President, Sullivan Machinery Co.

first case where a company has bound itself to follow a definite method, although the general idea has been practised in many if not most instances. Here the company has definitely formulated a method by which it binds itself and recognizes the obligations existing when it brings a man into a district, causing him to settle there and acquire property, real or personal. Under such circumstances, the company is in part responsible for seeing that, so far as possible, he shall not suffer a loss through unemployment. The man who goes into a district to engage in a definite type of work, for which there is there no other outlet, and who works for a company a long time has established a relationship with that company which has not always been clearly recognized. If he is no longer wanted in that company, for even the most excellent reasons, a loss is incurred by him which he is not in a position to bear.

In recent years, through studying the development of this question of personnel, there has come the recognition of the desirability for the individual to be guaranteed against loss. Probably it is an outgrowth of our appreciation of the benefits of insurance. In this case, a company has put itself on record as recognizing the interests of the men to be laid off, saying that it should be the men who will suffer the least loss. This is surely a most notable advance in the right direction.

Classification is probably open to further study to determine the question of whether these classes are of equal gradations of interest, and whether the men included in one group may not belong with another group.

C. H. BENEDICT,\* Calumet, Mich.—Our experience, without being formulated to that extent, was about along the same lines. We made three classes—the man with dependents, the single man, and the returned soldier. We took the stand that the community had a decided responsibility to the returned soldier so that we gave every soldier his position or the equivalent thereof. Very often it was hard to decide between the young man coming back from the war and some one who might not be so fortunately placed, yet we always took the stand that the soldier was entitled to the position if he wanted it. Occasionally we put the question up to the soldier, who very often would say that he would go somewhere else to look for a job. But when we laid off the men, we laid off the single man first. When it became absolutely necessary to lay off the men with dependents, an effort was always made to cause the least loss not only to the man but to the community as well. While companies may not have advertised the fact, I think there is a great deal of time and a great deal of consideration being given to this question by the management that is not appreciated by the community or possibly by the workers themselves.

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\* Metallurgist, Calumet & Hecla Mining Co.

THE CHAIRMAN (F. K. COPELAND,\* Chicago, Ill.).—Did you find, what seems to have been a very common experience, that the returned soldiers in many cases did not want their old jobs back, that they wanted something different?

C. H. BENEDICT.—In general, they were very glad to get their jobs back again, although a very large percentage of them later gave up their old jobs because they were dissatisfied.

G. M. TAYLOR,† Colorado Springs, Colo.—We had about 180 men go to war from the mines; about 15 per cent. of them returned and about a third of these quit in a month.

CHAIRMAN COPELAND.—There seems to be a great difference of experience with the returned soldier. I am very much interested in that question. In almost every case in my experience the men were glad to get their old jobs back. But I know that here in Chicago there has been much trouble; a man who had been a plumber wanted to be general manager, and so on, but our experience was contrary to that, the men were glad to come to work at their old jobs.

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### Report of Pyrometer Committee of National Research Council

Discussion of the paper of G. K. BURGESS, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2271.

F. E. BASH, Philadelphia, Pa.—In order to make a definite check on the emissivity of crucible steel under works conditions, a test was planned and executed by the plant of the Midvale Steel Co., by a Sub-committee, as follows: Five crucibles were put in a crucible furnace with the normal charge and were treated in the same manner as a number of others that were charged at the same time; the only difference was that the five crucibles had lids with 2-in. holes in the center. It was thought that after the crucibles were removed from the furnace a reading could be made through the hole in the lid with the optical pyrometer and that such a reading would give the true temperature of the steel as black-body conditions should prevail inside the crucible. If after obtaining the true temperature, the crucible lid were removed and the steel poured into the ladle, the apparent temperature could be taken by sighting on the steel stream and the emissivity obtained from the two temperature values.

Such a test was carried out with five crucibles. About a third of the crucibles charged into the furnace with the five experimental ones were first drawn from the furnace and poured into the ladle. The experimental crucibles were then drawn and readings of the true temperature were made

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\* President, Sullivan Machinery Co.

† Manager, Milling Dept., Portland Gold Mining Co.

through the hole in the lid from a raised stand erected for the purpose; the crucibles were then poured into a small ladle. While pouring them, a reading was made on the stream. It was not an easy matter to get this reading as the crucible was poured in about 8 to 10 sec., and often only a glimpse of the steel stream could be obtained as it was covered with slag during most of the time of pouring. However, by setting the lamp at a temperature very nearly that of the apparent temperature of the steel stream, some readings were obtained. In the case of three of the crucibles the reading had to be made on the slag stream as the steel was not visible.

As a further check on the apparent temperature of the steel, readings were made on the streams from all the remaining crucibles in that heat; these temperatures are tabulated below. The time recorded in the first column is the time that elapsed when the crucible passed through the door and the reading was made.

*Temperature Measurements on Crucible Steel*

| Time from Furnace,<br>Seconds | Temperature, Degrees F. |        | Remarks   |
|-------------------------------|-------------------------|--------|---|
|                               | Apparent                | True   |   |
|                               |                         | 2886   | Temperature in furnace before drawing crucibles |
| 12                            |                         | 2824   | First experimental crucible                     |
| 33                            | 2542(?)                 | (2761) | First experimental crucible, steel              |
| 15                            |                         | 2783   | Second experimental crucible                    |
| 30                            | 2560                    | (2783) | Second experimental crucible, steel             |
| 17                            |                         | 2818   | Third experimental crucible                     |
| 30                            | 2708                    | (2820) | Third experimental crucible, slag               |
| 30                            |                         | 2824   | Fourth experimental crucible                    |
| 45                            | 2703                    | (2814) | Fourth experimental crucible, slag              |
| 24                            |                         | 2802   | Fifth experimental crucible                     |
| 40                            | 2632                    | (2738) | Fifth experimental crucible, fumes              |
| Average                       |                         |        |   |
| time                          | 2722                    | (2834) | Reading on slag stream from pots                |
| from                          |                         |        |   |
| furnace                       | 2708                    | (2820) | Reading on slag stream from pots                |
| to                            |                         |        |   |
| pour                          | 2581                    | (2805) | Reading on steel stream from pots               |
| 20 sec.                       | 2567                    | (2790) | Reading on steel stream from pots               |
|                               | 2581                    | (2805) | Reading on steel stream from pots               |
|                               | 2581                    | (2805) | Reading on steel stream from pots               |
|                               | 2574                    | (2797) |   |
|                               | 2588                    | (2813) |   |
|                               | 2594                    | (2821) |   |
|                               | 2588                    | (2813) |   |
|                               | 2581                    | (2805) |   |
|                               | 2574                    | (2797) |   |

Teeming readings corrected for an emissivity of 0.40.

## TRUE TEMPERATURE, DEGREES F.

2680 Third ingot.  
2665 Fourth ingot.  
2665 Fifth ingot.  
2665 Sixth ingot.  
2656 Seventh ingot.  
2656 Eighth ingot.

## TRUE TEMPERATURE, DEGREES F.

2647 Ninth ingot.  
2647 Tenth ingot.  
2647 Eleventh ingot.  
2629 Twelfth ingot.  
2629 Thirteenth ingot.  
2629 Fourteenth ingot.

NOTE.—All temperature values enclosed in parenthesis, in the columns for true temperatures, are corrected for an emissivity of 0.40 in the case of steel and 0.65 for slag.

The readings in the table for the five experimental crucibles show that the corrections for emissivity of 0.40 for steel and 0.65 for slag, when applied to the apparent temperatures, give practically the same temperature values as the readings made in the crucible under black-body conditions, the greatest difference being 10° F. The correctness of these emissivity values is further verified by taking the mean of the true temperatures obtained by sighting into the five experimental crucibles and comparing them with the mean of the corrected temperature values obtained by sighting on the steel streams from the crucibles. The values are as follows:

|   | DEGREES F |
|---|-----------|
| Mean of true temperatures for five crucibles..... | 2810      |
| Mean of corrected readings on steel streams.....  | 2805      |
| Difference.....                                   | 5         |

The conclusions drawn from the above data are that under industrial conditions, the values for the emissivity of steel and slag are 0.40 and 0.65, respectively.

H. SCOTT, Washington, D. C. (written discussion\*).—It appears to me, from observations taken in a number of plants under Dr. Burgess' direction, that the simple and natural expedient of sighting on the bath will give the steelmaker the desired information. The measurements show remarkable consistency among themselves. On the other hand, it may be noted from other work, as Dr. Burgess' "Temperature Measurements in Bessemer and Open-hearth Practice"<sup>1</sup> and the report under discussion, that readings taken by this method (sighting on the bath) are not uniform enough to be used as a direct control of open-hearth heats for the variations in tapping temperatures are less than the observed bath temperatures.

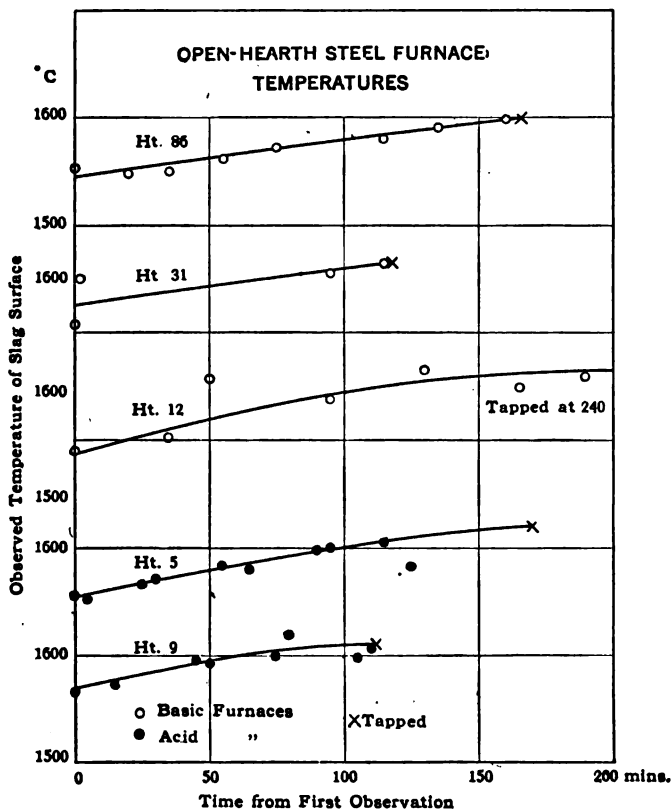
To support this opinion I have prepared the accompanying figure, which shows the temperature rise in open-hearth furnaces after the charge has melted down. Each value represents the average of several un-

\* Received Sept. 24, 1919.

<sup>1</sup> *Tech. Paper* 91, U. S. Bureau of Standards; also *Trans.* (1917) 56, 432.

corrected readings taken through the opening in the furnace door with the pyrometer used by Dr. Burgess. It may be noted that a smooth curve can be drawn representing the temperature rise with time, that only an exceptional value lies more than  $15^{\circ}\text{C.}$  off the curves, and that the extrapolated values for the tapping temperatures all lie between  $1600^{\circ}$  and  $1620^{\circ}\text{C.}$  ( $2912^{\circ}$  and  $2948^{\circ}\text{F.}$ ).

The discrepancies generally observed in readings taken on the bath may be associated with the two disconcerting conditions that always exist in open-hearth furnaces; namely, flames shooting across the line of



vision and the boiling of the bath. As both of these features are intermittent, it is possible, with the development of some skill, to obtain rational observations on the background of the slag surface. Thus, for example, by decreasing the brightness of the pyrometer lamp from that of the flames, a point is reached at which the filament no longer flashes bright when the flame momentarily ceases and *vice versa*. These readings represent temperatures just below or above, as the case may be, that of the bath. Care must be taken, however, that the reading is not

on the front surface of bubbles as these reflect the dark hole in the door and probably represent non-black-body conditions. I therefore think that the question can be properly brought up as to whether direct observations on the bath in the furnace do or do not give an acceptable criterion of open-hearth furnace temperatures.

### Recording Pyrometry

Discussion of the paper of C. O. FAIRCHILD and P. D. FOOTE, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1627.

R. W. NEWCOMB,\* New York, N. Y. (written discussion†).—On page 1638 mention is made of a new instrument with an exceptionally high resistance that has been developed by Charles Engelhard. All friction and wear of moving parts of the moving system has been eliminated by replacing the hardened steel pivots and jeweled bearings, commonly used on other instruments, by a double metallic filament, one at the top and one at the bottom, under slight tension. Any possible distortion of the moving coil, because of tension, has been eliminated by introducing a solid spindle as the axis of the coil between the points on the coil where the metallic filament is attached. The filaments serve not only as a support for the moving coil; but also to lead in the current from the binding posts to the moving coil, and as a source of counter-torque; instruments so constructed do not require leveling, and are mechanically very robust.

The clock of the recorder serves only to drive the chart at its specified rate and to operate a small contact-making device; i.e., there is no other mechanical load on the clockworks. The contact-making device is so constructed that there is a quick-make, a quick-break, and a wiping effect while the contact is being made. Contact surfaces on this switch are of platinum platinum-iridium. The operation of this contact, which occurs once each minute, sends a current, from a 6-volt supply, through a solenoid magnet, which operates the depressor bar mechanism in the case of the single-record instrument; in the case of the multiple-record instrument, it operates the automatic switch and color-changing features, as well as the depressor bar.

A new method of inking is employed. On the single-record recorders the paper passes over a small roller about  $\frac{1}{4}$  in. in diameter, which is located directly across the instrument, beneath the depressor bar. The paper is held clear from the roller surface by small hubs located at each end. The roller is covered with a fabric tube, impregnated with

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\* With Charles Engelhard.

† Received Nov. 1, 1919.

the inking compound, and is slowly turned by the passage of the paper. The pointer swings above the chart and below the depressor bar. When the depressor bar falls, the position of the pointer at its intersection with the color-carrying roll underneath the chart is recorded. On the multiple-record instruments, there are as many rollers as the capacity of the multiple-recorder in thermocouples, *i.e.*, on a four-point recorder there are four rollers, on a six-point recorder, six rollers, etc.

The operation of the automatic switch that controls the rollers, the depressor bar, and the color-changing mechanism is accomplished by the solenoid magnet; the up-and-down motion of the magnet is changed into a rotating motion for the operation of the switch and color-changing mechanism, by a double-acting locking pawl engaged with a pinion. When the small contact switch on clockwork makes contact, the armature of the magnet is drawn down, allowing the depressor bar to record the position of the pointer corresponding to the temperature of the thermocouple. As soon as the contact is broken, the reacting spring on the solenoid magnet turns the automatic switch and color-changing mechanism to the next point.

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### Use of Optical Pyrometers for Control of Optical-glass Furnaces

Discussion of the paper of C. N. FENNER, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 151, July, 1919, p. 1001.

CLARENCE N. FENNER.—Mr. Gelstharp, chief chemist of the Pittsburgh Plate Glass Co., has directed my attention to the fact that that company was using optical pyrometers obtained from the Leeds & Northrup Co. several months before the members of the Geophysical Laboratory arrived at Charleroi. I am glad to make this correction. The chief object of my paper was to emphasize the necessity of careful temperature control in the making of optical glass and to describe the kind of tests to which an optical pyrometer should be subjected at a glass plant in order to obtain information regarding the closeness with which its readings correspond with true temperatures under the conditions which prevail in each particular case.

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### Pyrometry in Blast-furnace Work

Discussion of the paper of P. H. ROYSTER and T. L. JOSEPH, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 1953.

A. L. FEILD, Cleveland, Ohio (written discussion\*).—In equation 2,  $B$  is used to denote the ratio of bases (lime plus magnesia) to acids (alumina plus silica) it being stated that this ratio gives more concordant

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\* Received Sept. 24, 1919.

results than the ratio either of bases to silica, or of lime to silica. I find, however, that, by making use of the ratio between true CaO (CaO by analysis minus sulfur calculated to CaS) to acids, equation 2 may be modified to agree with the observed facts within an average error of 0.0041 per cent. sulfur instead of 0.0045 per cent. The revised equation is

$$s = 0.072 + 0.0183S - 0.00061(t - 1400) - 0.0403B$$

where  $B$  is the ratio of true CaO to  $Al_2O_3$  plus  $SiO_2$ , and the other symbols have the same significance as before.

I would not appear to stress too much this slightly better agreement of the revised equation with the observed sulfur. Yet I believe that the use of this ratio of true CaO to acids is to be preferred, if for no other reason than the fact that it is more in harmony with the previous findings of the Bureau of Mines with regard to the effect of magnesia and other impurities on slag viscosity.<sup>1</sup>

The empirical relations found for the twenty furnaces investigated should be of great interest both to the metallurgist and the furnaceman, but to establish firmly the validity of these equations, the investigation should include a somewhat wider range of practice. For instance, Table I includes no pig iron with more than 0.050 per cent. sulfur. So far as this element is concerned, all the cases cited fall within what is generally designated as good practice in the case of foundry, basic, or bessemer iron, but the examples do not cover the entire range of good practice. Iron with 0.060 per cent. sulfur is quite commonly used in the basic open-hearth. Data for several irons a little high in sulfur or off-grade would permit a proper estimate to be placed upon the value of equation 2 as an instrument in everyday works control. Similarly, equation 1, dealing with the per cent. of silicon in the metal, would be even more convincing if it were to apply to a wider range than from 0.96 to 1.76 per cent. silicon. Nevertheless, even within the range of practice covered, it is remarkable that any arithmetical relations, however empirical, have been established.

Probably the statement that will meet the most opposition from furnacemen is that the sulfur in the metal is not, in general, lower with high silicon metal. I believe, however, it is possible to reconcile the accepted silicon-sulfur theorem with this radical conclusion. The latter is based on observations on twenty different furnaces, operated under diverse conditions and with the usual differences in dimensions, tendency toward slips, uniformity of blast distribution and stock descent. While it has been possible to derive from such data empirical formulas that hold remarkably well for the case of silicon and of sulfur, taken separately,

<sup>1</sup> A. L. FIELD and P. H. ROYSTER: Slag Viscosity Tables for Blast-furnace Work. *Tech. Paper* 187 (1918) 4 et seq.

it would be much more difficult to correlate silicon and sulfur over the wide range of practice selected. It is hoped that the validity of equations 1 and 2 will be further proved by a series of experiments on a single furnace, covering a considerable range of sulfur and silicon values. By confining the application of the two equations to a single furnace, a relation may be deduced which will show that, in these circumstances, the sulfur in the metal is, in general, lower with high silicon content.

By making a single assumption, which appears permissible, it can be shown from the data in Table 1 that there is a well-defined relation between silicon and sulfur, and of the sort expected. It will be observed that the corresponding temperatures of slag and metal, given in columns 3 and 4 respectively, do not differ on the average by more than 51°. Measurements of slag and metal temperatures are subject to experimental errors, particularly the former. If 10° is subtracted from the slag temperatures, as suggested by Messrs. Royster and Joseph, to correspond to an emissivity of 0.70 instead of 0.65, the average difference between slag and metal temperatures will be only 41°. For our present purpose, we will assume that the temperatures of slag and metal are equal for any given furnace. It is then readily proved that equations 1 and 2 may be combined, thus

$$Si + 2s \left( \frac{FM}{47.7} \right) = \frac{FM}{47.7} \left( 0.263 + 0.36S - 0.0732B + 0.143 \frac{T}{D^2} \right) \quad (a)$$

where  $Si$  is equal to the silicon in the metal,  $S$  the per cent. of sulfur in the slag, and the other symbols have their former significance.

If desired,  $B$  may be replaced by  $B'$ , where  $B'$  is equal to the ratio of true lime to alumina plus silica, in which case the equation becomes

$$Si + 2s \left( \frac{FM}{47.7} \right) = \frac{FM}{47.7} \left( 0.260 + 0.36S - 0.0792B' + 0.143 \frac{T}{D^2} \right) \quad (b)$$

An examination of equation  $a$  shows that when the pounds of coke per ton of metal, the per cent. of silica in the coke, the tons of metal made in 24 hr., the sulfur in the slag, and the basicity of the slag are held constant, the quantity

$$Si + 2ks = \text{constant} \quad (c)$$

where  $k$  is a constant equal to  $\frac{FM}{47.7}$ . In order for  $(Si + 2ks)$  to be constant, it is necessary for the silicon to go up when the sulfur goes down, and vice versa. Such a change might be produced by a fall in blast temperature, an increase or decrease in atmospheric moisture, or a change in the regularity of movement of the stock. For this particular furnace, therefore, a sudden unexpected increase or decrease in silicon is accompanied by an opposite change in the sulfur content. If lime or coke is put on or taken off, there is another set of conditions to which

equation  $c$  applies, but with a different value for the constant on the right hand side of the equation.

Since the values for  $M$ , the per cent. silica in the coke, and for  $D$ , the diameter of the hearth are not given, it is not possible to apply equations  $a$  or  $b$ . Such a computation would be interesting as it would indicate what percentages of silicon would be expected for various arbitrarily chosen sulfur values. The silicon-sulfur curves for each of the twenty furnaces might disclose some important relationships.

With regard to the effect of slag viscosity on silica reduction, it has been deduced elsewhere,<sup>2</sup> on theoretical grounds, that a fluid slag is not necessary because diffusion is a minor item. I would like to see, however, some attempt made to correlate desulfurizing power with slag viscosity, temperature, and basicity. The sulfur distribution between slag and metal is probably largely a matter of diffusion, although we do not possess such quantitative proof of the theory as Messrs. Royster and Joseph have offered in support of the principal conclusions of their paper.

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### Aircraft Steels

Discussion of the paper of ALBERT SAUVEUR, presented at the Chicago meeting, September, 1919, and printed in *Bulletin* No. 153, September, 1919, p. 2323.

GEORGE K. BURGESS,\* Washington, D. C. (written discussion†).—Professor Sauveur refers to the International Aircraft Standards Board in terms that would indicate his non-familiarity with the organization and the working of this Board which, of course, is excusable on account of Professor Sauveur's absence in Europe at the time. He implies that the work of this Board was entirely dominated by American interests, whereas diametrically the opposite was the case. The Board was organized for the purpose of facilitating purchase in the United States, on the basis of common specifications, by the Allied air services in the United States, and the Board performed a very valuable service in unifying the specifications of Italy, Great Britain, France, Canada, and the United States for such purposes. The proceedings of the Board were carried out on the basis of unanimous agreement of the representatives of the five countries and all the members from each of the countries were technical specialists or had the advice of technical assistants. It would be difficult to find an instance of greater unity of purpose, readiness to compromise, and efficient production than was shown by this Board, which produced seventy-eight specifications, in the preparation of which representative American manufacturers appeared before the Board.

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<sup>2</sup> Bureau of Mines *Tech. Paper* 187, 14–15.

\* Chief, Division of Metallurgy, U. S. Bureau of Standards.

† Received Oct. 6, 1919.

In no case was a specification adopted until assurance was given not only of adequate manufacturing facilities but of willingness to manufacture under the specification in question. Many of these specifications were taken over bodily by the United States Signal Corps, and they have since been widely quoted in the technical press, handbooks, etc. The work of this Board ceased with the International Aircraft meeting in London in 1918, as it was expected that this later organization would continue the work on a more comprehensive basis for purchases in all allied countries.



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## Book Notices

**CATALYSIS IN INDUSTRIAL CHEMISTRY.** By G. G. Henderson. Lond. and N. Y., Longmans, Green and Co., 1919. 202 pp., cloth, 9 × 6 in., \$3.25.

This, the latest volume of the series of Monographs on Industrial Chemistry which is being published under the editorship of Sir Edward Thorpe, is intended to present broadly our present knowledge of the phenomenon of which it treats. The book reviews the existing literature on catalysis, paying particular attention to the many applications now used in industry.

**COMMERCIAL OILS—VEGETABLE AND ANIMAL.** With special reference to Oriental Oils. By I. F. Laucks. 1st edition. N. Y., John Wiley and Sons, Inc.; Lond. Chapman and Hall, Ltd., 1919. 138 pp., cloth, 8 × 5 in., \$1.25.

Intended to give to men in the oil trade, who have not had technical training, the technical data and information required in every-day dealings, in concise form.

The various commercial oils are listed, together with their sources, uses, and physical and chemical characteristics. The values have been collected from the standard texts, supplemented, particularly in regard to oriental oils, by the results obtained in the author's laboratory.

**FIFTY YEARS OF IRON AND STEEL.** By Joseph G. Butler, Jr. Cleveland, The Penton Press, 1919. 145 pp., por., 10 × 6 in., leather. (Gift of author.)

This volume is one of a special edition, of 100 copies, of an address delivered before the American Iron and Steel Institute in 1917, in which the author gives his personal reminiscences of the development in iron and steel making, as observed during an active participation in the industry in eastern Ohio, which began in 1857. To this are added some brief data on the early history of iron and steel, and a chapter on the activities of the American iron manufactures during the great war. The volume is profusely illustrated with portraits of men of note in the industry.

**HYDROLOGY.** The Fundamental Basis of Hydraulic Engineering. By Daniel W. Mead. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 647 pp., illus., maps, tables, 9 × 6 in., cloth, \$5.00.

Lack of knowledge of the fundamentals of hydrology and of the importance of hydrological factors has been responsible, the author believes, for more failures in hydraulic engineering projects than defects in structural design. To assist in removing this ignorance he has here set down some of the more important facts and principles, omitting everything that his long experience has not shown to be of practical importance. Carefully selected lists of references are appended to each chapter, to enable readers to complete their study of any phase of the subject which has not been sufficiently treated within the limits of the book itself.

**MANUAL OF PHYSICAL MEASUREMENTS.** By Anthony Zeleny and Henry A. Erikson. 4th edition. 261 pp., 129 illus., tables, 8 × 5 in., cloth, \$2.00.

This manual is an outline of the laboratory course given to students of general physics at the University of Minnesota; 133 experiments are included. Directions for assembling the apparatus and performing the experiments are given. Appendixes give the mathematical tables needed by users of the book.

**OXY-ACETYLENE WELDING MANUAL.** By Lieut. Lorn Campbell, Jr., 1st edition. N. Y., John Wiley & Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 154 pp., 92 illus., 1 pl., cloth, 8 × 5 in., \$1.25. (Wiley Engineering Series.)

An instruction book for beginners by the officer in charge of welding instruction in the U. S. A. Ordnance Department. The work is confined to shop practice, and is intended to provide a systematic, standardized method of instructing, adapted to class use and as a reference book in the shop.

**PHYSICAL CHEMISTRY OF THE METALS.** By Rudolph Schenck. Translated and annotated by Reginald Scott Dean. 1st edition. N. Y., John Wiley and Sons, Inc.; Lond., Chapman & Hall, Ltd., 1919. 239 pp., illus., tables 9 × 6 in., cloth, \$3.00.

The outcome of a course of lectures delivered in the Technischen Hochschule at Aachen. The purpose of the lectures was to show the use of chemical statics and to explain the applications of physical chemistry in the study of smelting operations and metallurgical processes. The translator has made additions to the original text when necessary and has revised the numerical data to agree with the accepted values.

**PRACTICAL MATHEMATICS FOR HOME STUDY.** Being the essentials of Arithmetic, Geometry, Algebra and Trigonometry. By Claude Irwin Palmer. 1st edition. N. Y., McGraw-Hill Book Co., Inc.; Lond., Hill Publishing Co., Ltd., 1919. 493 pp., illus., tab., cloth, 8 × 5 in., \$3.00.

During the past fifteen years the author has taught mathematics in the evening school at the Armour Institute of Technology to classes of men engaged in practical pursuits of various kinds. For this purpose a course of instruction was published in four volumes, which has now been arranged in one volume, with particular reference to the needs of home students. A few new topics have been added, together with many solutions of problems.

The book includes arithmetic, geometry, algebra, logarithms and trigonometry. It is intended for adult students, and the three thousand exercises and problems are selected to illustrate actual practical problems.

**RETAINING WALLS.** Based entirely on the Theory of Friction. By Pedro Dozal. Done into English by R. T. Mulleady. 1st edit. Buenos Aires. M. A. Rosas, 1918. 161 pp., 62 illus., cloth, 11 × 7 in. (Gift of author.)

The author presents a general theory in regard to the static pressures acting on a plane cutting an unbounded coherent, incoherent or liquid mass in equilibrium, and its application for the calculation of the pressures on retaining walls. The theory advanced differs from those presented by Rankine and other students of the subject and gives notably different results.

**STEAM TURBINES.** A Practical and Theoretical Treatise for Engineers and Students, including a discussion of the Gas Turbine. By James Ambrose Moyer. 4th edition, revised and enlarged. N. Y., John Wiley and Sons, Inc.; Lond., Chapman and Hall, Ltd., 1919. 496 pp., illus., diag., tables, 1 folded chart, 9 × 6 in., cloth, \$4.

This edition differs from the preceding ones by containing fuller discussions of the methods of governing, the calculation of the strength of disk-type blade wheels, and of recent developments in marine practice. The text as a whole has also been revised. The general purpose of the volume is to provide the designer, operator or manufacturer of steam turbines with a concise manual of information, based on practical experience.

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#### Accessions

**AMERICAN METRIC ASSOCIATION.** Third Annual Report. 1918. (Gift of John Francis.)

**ASBESTOS.** Vol. 1, No. 3. September, 1919. Furnishing a common vantage ground where those interested in asbestos and magnesia may meet for discussion. (Gift of Secretarial Service, Philadelphia, Pa.)

- BIBLIOGRAPHY OF INDIAN GEOLOGY AND PHYSICAL GEOGRAPHY, WITH AN ANNOTATED INDEX OF MINERALS OF ECONOMIC VALUE.** Compiled by T. H. D. La Touche. Calcutta. 1917. In 2 parts. (Gift of Geological Survey of India.)
- BRITISH ENGINEERING STANDARDS ASSOCIATION No. 84.** Report on British Standards Fine B. S. F. Screw Threads and Their Tolerances. London.
- CHEMICAL COMBINATION AMONG METALS.** By Michele Giua and Clara Guia-Lollini.
- CHEMISTRY AND MANUFACTURE OF HYDROGEN.** By I. L. Teed. 1919. London.
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- COLOR IN RELATION TO CHEMICAL CONSTITUTION.** By E. R. Watson. N. Y.
- DEUTSCHER AUSSCHUSS FÜR EISENBETON.** Versuche mit Eisenbetonbalken zur Ermittlung der Widerstandsfähigkeit von Stossverbindungen der Eiseneinlagen. Dresden. 1913. Reprint.
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- ELECTRO-ANALYSIS.** By Prof. Edgar F. Smith. Revised and enlarged. 6th edit. 1918.
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- GROWING NEED IN THE PETROLEUM INDUSTRY.** By Van H. Manning. (Leaflet.) (Gift.)
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- JAARBOEK VAN HET MIJNWEZEN IN NEDERLANDSCH OOST-INDIË.** 1900-1917. Atlas for 1916.
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Illustrations and Descriptions of Practical Mailing Devices.
- LIDGERWOOD MFG. Co., New York City.  
Lidgerwood Machinery Bulletins.

- MAGNESIA ASSOCIATION OF AMERICA, Philadelphia, Pa.  
Anniversary Advertising Portfolio of 85 per cent. Magnesia. 1917.
- PENNSYLVANIA WIRE GLASS Co., Philadelphia, Pa.  
Unit Daylight Building using Corrugated Wire Glass. Plan.
- SINCLAIR MOTOR Co., Inc., New Orleans, La.  
Sinclair Motors.
- SARCO Co., Inc., New York City.  
Steam Trap Sarco.
- U. S. LIGHT & HEAT CORPN., Niagara Falls, N. Y.  
Electric Arc Welding. Bull. 700. June 2, 1919.

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## CONFERENCE OF REPRESENTATIVES OF FEDERAL MAP- MAKING ORGANIZATIONS

Following the suggestion of Engineering Council and at the direction of the President, representatives from each of the Federal Government bureaus interested in map-making were called into a conference for the purpose of coördinating all of the Government's map-making activities. This conference has now reported back to the President the results of its findings, which indicate that Engineering Council's recommendation in this matter was well founded. While the conference report states that its members were of the opinion that little duplication of effort existed, it recommends the formation of a permanent Board of Surveys and Maps. An extended review of the map-making activities, which is given as an appendix to the report, indicates that this recommendation is a logical step. The conference recommendations concerning this Board of Surveys and Maps are as follows: (1) the Board is to be composed of representatives of mapping bureaus to be assisted by outside engineering organizations, which have been named above; (2) the establishment of an information office in one of the Government bureaus, preferably the Geological Survey, which is to be under the supervision of the Board and is to be a mapping information clearing house for the Government and outside engineering organizations; (3) copyright laws are to be so changed that copies of all maps made in the United States and with Governmental authority, will go to the central information office; (4) the Government departments are to receive orders to cooperate with the Board; (5) future topographic maps of all kinds are to conform with specifications for the standard topographic map; (6) the U. S. Coast and Geodetic Survey to have supervision of final adjustment of all important control data under specifications approved by Board of Surveys and Maps; (7) surveys in the form of maps and publications are to be issued as soon as possible after field work has been completed; (8) program of the Interdepartmental Committee on Aerial Surveying was approved.

Outside technical and scientific organizations that are called in for consultation are to operate in an advisory capacity only, responsibility for action on Governmental work is to rest solely with the Governmental agencies.

## INDUSTRIAL SECTION

This department is devoted to material concerning the products or operations of manufacturers, which, in the estimation of the Editor, is of news value to the mining and metallurgical field, but does not come within the scope of the main editorial section of the Bulletin.

Manufacturers are invited to submit to the Editor items descriptive of new equipment or processes, large or significant installations, and similar material of news character. If found available, items thus furnished will be published in this section without charge, subject to such editorial revision and condensation as may be necessary.

In cases where illustrations are required, cuts of the proper size should accompany the text matter.

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### METALKASE MAGNESITE BRICK

An ingenious form of magnesite brick, said to be especially adapted for service in open-hearth and electric furnaces, is described in a pamphlet recently issued by the Harbison-Walker Refractories Co. of Pittsburgh. These brick consist of round or square soft steel containers, open at the ends and of a convenient size for handling and laying, packed with ground deadburned magnesite of the highest obtainable quality. They are always laid in furnace walls as headers with the ends exposed to the heat and without any cement except that required to fill up the open spaces between the containers and circular cross-sections. They can very generally be substituted to advantage for magnesite and chrome brick, and for silica brick under certain special conditions. The most common use of the metal-encased brick is in the backwalls, bulkheads, and ends of the basic open-hearth steel furnace and in the sidewalls of the electric furnace.

The particular advantage claimed for the Metalkase brick is that this method of construction results in the practical elimination of all joints exposed to the flame and overcomes difficulties resulting from spalling. At operating temperature, the metal casing fuses for a distance of 1 to 2 in. back from the face exposed to the heat, impregnates the magnesite and binds together the entire face of the wall into a jointless, monolithic surface. Because of the slightly porous texture and the stiffening effect of the unmelted portion of the containers, Metalkase brick do not spall when subjected to rapid heating and cooling.

### CHOOSING A METER TO MEASURE FLOW OF WATER IN PIPE LINE

The selection of the type of meter to be employed in measuring the flow of water through a pipe line should be based upon the consideration of the difficulties of installation, permanency of operation, accuracy of measurement, and the cost of installation and maintenance. Tests to determine the practicability of employing thin-plate orifices in pipe lines, and the conditions most favorable for their use as measuring devices, have been completed by the Engineering Experiment Station of the University of Illinois under the direction of R. E. Davis, associate in civil engineering, and H. H. Jordan, assistant professor in general engineering drawing. The tests were conducted with three sets of orifices of eight different diameters per set cut in  $\frac{3}{16}$ -in. steel plates. Data were obtained

from 4-in., 6-in., and 12-in. pipe systems respectively. The results of these tests are given in detail in Bulletin No. 109 entitled, "The Orifice as a Means of Measuring Flow of Water through a Pipe." Copies of this Bulletin may be had, without charge, by addressing the Engineering Experiment Station, Urbana, Illinois.

### ALLIS-CHALMERS PROSPECTING MILL, FOR FREE GOLD ORES

This prospecting mill has been designed to meet the demand for a light, compact plant, capable of being easily and quickly taken apart, transported and erected where desired; the mill can be made sectional for mule-back transportation at a slight additional cost. The three-stamp mill, 250 lb. each stamp, is of improved design and is arranged to be operated in one battery by belt from stamp countershaft. The mortar, weighing about 1000 lb., is arranged for copper amalgamation plates in front and back.

### THE WYOMING-MAYARI SHOVEL

Mayari steel is manufactured from a natural chrome-nickel-iron ore mined in Mayari, province of Oriente, Cuba. Chrome-nickel steel made from this ore is remarkably uniform. As Mayari steel is a natural alloy steel it can be furnished at a reasonable advance in price over the ordinary carbon steel. The steel of the Wyoming Mayari shovel, made by the Wyoming Shovel Works, Wyoming, Pa., is a natural alloy of almost uncanny hardness, yet springy and tough to a degree that is the marvel of shovel users wherever this shovel has been exhibited or used.

The Dirigo handle consists of two parts: the stem, of second growth Northern White Ash, and a malleable cross piece. The objection to a handle cold to the touch is overcome by the dead-air space in the grip. This handle cannot check, crack, come loose, nor be broken with ordinary usage. It can be used for tamping, at the same time being light and not at all cumbersome. It forms a universal handle for all kinds of shovels, spades, and scoops and can be carried in stock indefinitely, without loss from shrinkage or checks.

### INDUSTRIAL NOTES

The firm of Vahrenkamp & Elder, Rialto Building, San Francisco, California, has been discontinued, and will henceforth be known as Fred. H. Vahrenkamp & Co., 675-677 Monadnock Building, San Francisco, Calif., Fred H. Vahrenkamp, President.

The report on the United States Housing Corporation, Vol. 11, is one of the most complete reports on the subject of planning of houses for workingmen issued in this country. It deals exclusively with the architectural, town planning, and engineering divisions of the corporation and contains more than 200 cuts of house plans and elevations, architectural and engineering features and statistics on 26,000 houses, the number originally planned by Corporation for war needs.

# LOCOMOTIVES

Twenty-eight loaded cars up a 2½% grade. Total load about 112 tons, started and hauled.

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# HOISTS

# THE MINING AND METALLURGICAL INDEX

October, 1919

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## MINERAL RESOURCES EXCLUSIVE OF COAL AND OIL

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- GOLD-QUARTZ** veins and scheelite deposits in Southeastern Manitoba. E. L. Bruce, *Canad. Dept. Mines, Summary Report*, 1918, pt. D, No. 1764 (1919) 11D-15D. 2000 w.
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- NICKEL** industry of Canada. From data prepared by D. H. Browne, *Canad. Chem. Jnl.* (Feb., 1918) 2, 40-3. 4000 w. Serial. Also (March, 1919) 2, 67-8. 1800 w. Concluded.
- PLATINUM** situation in Canada, 1918. J. J. O'Neill, *Canad. Dept. Mines, Summary Report*, 1918, pt. G, No. 1748 (1919) 1G-15G.
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## NON-METALLIC MINERALS

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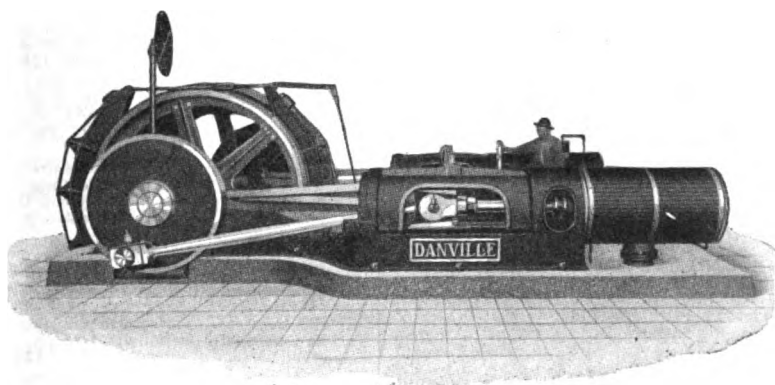
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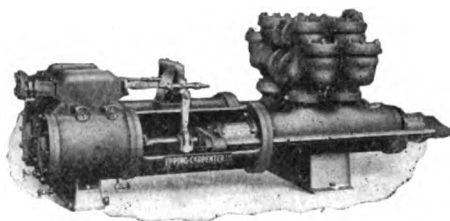
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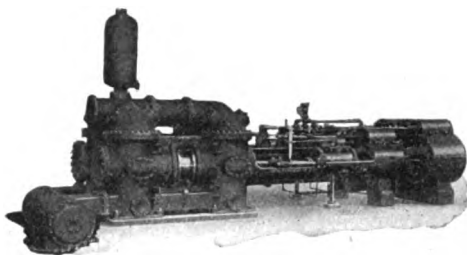
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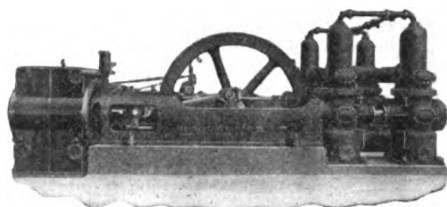
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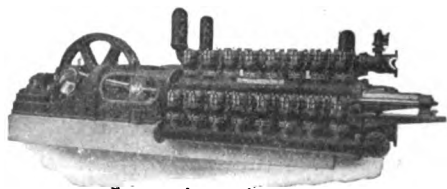
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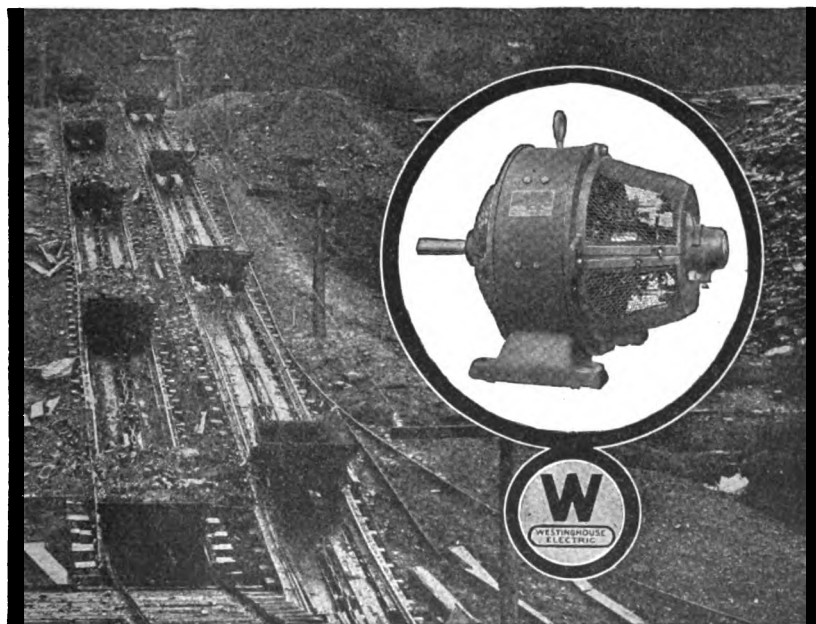
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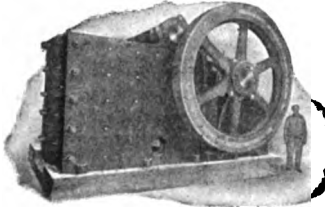
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- CORES, Mechanical production of. Mechanische Herstellung vom Kernen. *Ztsch. Ges. Glaserispraxis* (July 5, 1919) 363-3. 600 w.
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- ELECTRIC cranes in steelworks, Overhead. J. Smith, *Electn.* (Sept. 26, 1919) 83, 355-62. 4000 w. Applications.
- EXTRUDING metal, Machine for. D. L. Summey, U. S. Pat. 1317238. *Off. Gas.* (Sept. 30, 1919) 266, 619. 160 w.
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- FATIGUE tests of nickel and chrome-nickel steel. *Engrg. Wld.* (Oct. 15, 1919) 15, 31-4. 1500 w.
- FOUNDRIES, Financial possibilities of. Ueber die Rentabilität von Gießereien. *Metall-Technik* (June 28, 1919) 97-8. 900 w.
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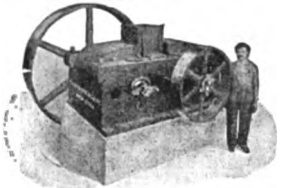


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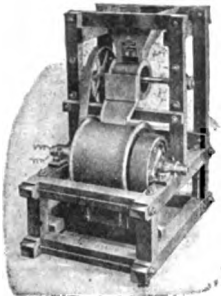
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- GERMAN iron and steel industry of the occupied territory on the left bank of the Rhine. Report on the present status of fuel economy in the. C. Johns and L. Ennis, Iron and Steel Inst. *Advance Copy* (Sept., 1919) 19 pp.
- HARDNESS of steel, Machine for testing the. D. C. Davis, *Canad. Pat.* 192938. *Off. Rec.* (Sept. 30, 1919) 47, 1659-60. 225 w.
- IRON and steel industries in some of the neutral countries of Europe, Future of the. J. W. Richards, *Jnl. Am. Steel Treat. Assn.* (Oct., 1919) 2, 32-6. 2000 w.
- IRON oxides upon the acid furnace structure. Action of. J. H. Whiteley and A. F. Halli-mond, Iron and Steel Inst. *Advance Copy* (Sept., 1919) 21 pp.
- JAPAN'S iron industry, Development of. B. K. Nakashima, *Trans-Pacific* (Oct., 1919) 1, 1-7. 4500 w.
- LIFTING magnet practice, Developments in. F. N. Pickett, *Electn.* (Sept. 28, 1919) 63, 349-52. 2000 w. Applications to handling of iron.
- MAGNETS, Steel for. *Mech. Wld.* VII. (Sept. 26, 1919) 66, 148-9. 1500 w. Serial.
- MALEABLE iron, Sulphur reduced in. A. W. Merrick, *Foundry* (Oct. 1, 1919) 47, 685-7. 2000 w. Read before Am. Fdy. Assn., Sept. 29, 1919.
- MALEABLE iron, Machining qualities of. E. K. Smith and W. Barr, *Foundry* (Oct., 1, 1919) 47, 682-4. 2000 w. Read before Am. Fdy. Assn., Sept. 29, 1919.
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- PHOSPHORUS in soft acid and basic open-hearth steels, Effect of. J. S. Unger, *Proc. Steel Treat. Research Soc.* (1919) 2, No. 1, 11-23. 3500 w. Results of investigation.
- PULVERIZING metals. E. Odam, *British Pat.* 129631. *Ill. Off. Jnl.* (Sept. 17, 1919) 2906. 225 w.
- PYROMETERS, Standards of temperature and means for checking. *Proc. Steel Treat. Research Soc.* (1919) 2, No. 1, 30-7. 5000 w.
- ROLLING mills, Electrical driving of. A. P. Pyne, *Electn.* (Sept. 26, 1919) 63, 224-32. 6500 w.
- SIDERURGICAL problem in Peru. Ideas generales sobre el problem siderurgico en el Perú. E. I. Dueñas, *Inform. y. Mem. Soc. Ing. Peru* (Sept., 1919) 21, 439-46. 2800 w.
- SMELTING furnace without crucibles, New. Ein neuer tiegelloser Schmelsofen. H. Rhode, *Metall.* (June 25, 1919) 160-1. 800 w.
- SMELTING iron in Sweden 200 years ago. P. Bonde, *Iron Tr. Rev.* (Oct. 16, 1919) 65, 1046-7. 1200 w.
- SOME faults of airplane metals. W. J. May, *Mech. Wld.* (Oct. 3, 1919) 66, 162. 1400 w. Serial.
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- STEEL works, Mitsubishi. A. Farrell, *Pacific Marine Rev.* (Oct., 1919) 16, 89. 1200 w.
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- TESTS of steel, Practical notes on physical. A. B. Wilson, *Blast Fur. & Steel Plant* II. (Oct., 1919) 500-2. 2200 w. Serial.
- TINPLATE manufacture, Fatigue research in. H. M. Vernon, *Iron & Coal Tr. Rev.* (Sept. 12, 1919) 99, 336. 3000 w. From report of investigation. *Engng.* (Oct. 10, 1919) 106, 484-6. 4000 w. Reviews report of H. M. Vernon.
- TINPLATES, Machine for cleaning. S. E. Diescher, U. S. Pat. 1318483. *Off. Gaz.* (Oct. 14, 1919) 267, 218. 80 w.
- TUNGSTEN steels, On some physical constants of. K. Honda and T. Matsushita, *Sci. Repts. Tohoku Imp. Univ.* (Aug., 1919) 2, 89-98. 1800 w.
- WIERTON Steel builds modern furnace. *Iron Tr. Rev.* (Oct. 2, 1919) 65, 921-4. 2000 w. Blast furnace in W. Va.

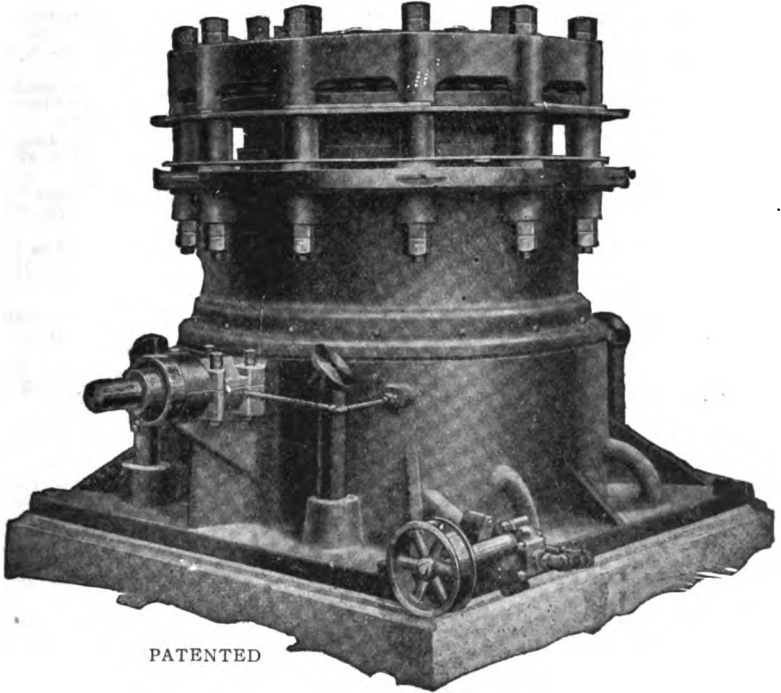
## FIRE

- ANNEALING and tempering wire. H. Parkin, *British Pat.* 130811. *Ill. Off. Jnl.* (Oct. 8, 1919) 3362. 150 w.
- ANNEALING, Graphitization of white cast iron upon. *Bull. A. I. M. E.* (Oct., 1919) 2938-42. 1500 w. Discussion of paper of P. D. Merica and L. J. Gurevich.
- ANNEALING malleable iron, Experiments in. H. E. Diller, *Canad. Foundryman* (July, 1919) 10, 184-6. 2000 w.
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- ANNEALING, Using pulverised coal for. C. Longenecker, *Foundry* (Oct. 1, 1919) 47, 680-1. 1200 w.
- BLAST-FURNACE, Apparatus for charging. T. Kawai, U. S. Pat. 1319005. *Off. Gaz.* (Oct. 14, 1919) 267, 318. 65 w.

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- BLAST-FURNACE** plant, Electrical practice in the equipment of. J. P. Hodges, *Electn.* (Sept. 26, 1919) 83, 333-8. 5000 w.
- CASE-HARDENING**, Practical talks on. T. G. Selleck, *Jnl. Am. Steel Treat. Soc.* II. (Oct., 1919) 2, 40-7. 3000 w.
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- CAST** iron and its application, Oxygen in. *Bull.* A. I. M. E. (Oct., 1919) 2931-4. 1500 w. Discussion of W. L. Stork's paper.
- CASTING** in a very small foundry, Making a big. J. B. Lloyd, *Canad. Foundryman* (May, 1919) 10, 122-3. 1000 w.
- CASTING** metal chains. National Malleable Castings Co. British Pat. 129641. *III. Of. Jnl.* (Sept. 17, 1919) 2909. 150 w. Also British Pat. 129642. 65 w. British Pat. 129643. 2910. 200 w.
- CASTING** metals, etc. A. W. Morris, British Pat. 130900. *III. Of. Jnl.* (Oct. 8, 1919) 3379-81. 1000 w.
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- CASTING** moulding-flasks. D. J. Gascoigne, British Pat. 131263. *III. Of. Jnl.* (Oct. 15, 1919) 3513. 100 w.
- CASTINGS**, Characteristics of steel. Les caractéristiques de la fonte acérées. *Méaux. Alliages et Mach.* (Sept., 1919) 3-4. 2000 w.
- CASTINGS**, Chilled iron. W. Muirhead, British Pat. 131110. *III. Of. Jnl.* (Oct. 15, 1919) 3457-8. 150 w.
- CASTINGS**, Fine-skinned or faced. W. J. May, *English Mach.* (Oct. 3, 1919) 110, 121. 1500 w.
- CASTINGS**, Production of fine-skinned. J. B. Lloyd, *Canad. Foundryman* (June, 1919) 10, 150. 1000 w.
- CASTINGS**, Production of malleable iron. F. Perry, U. S. Pat. 1319612. *Of. Gas.* (Oct. 21, 1919) 267, 459. 30 w.
- CONVERTER** castings are made, Where. *Foundry* (Sept. 1, 1919) 47, 608-11. 2500 w.
- CUPOLA** practice, Fuel economy in. H. J. Yates, *Iron and Steel Inst. Advance Copy* (Sept., 1919) 7 pp. 2000 w.
- DIE-CASTING** and die-casting metals. E. Oberg, *Machy.* (Oct., 1919) 26, 155-60. 4000 w.
- DUST** in foundries, Means of diminishing. Die mittel zur vermindering des staubes in giesereien. *Metall-Technik* (May 31, 1919) 81-2. 1700 w.
- EXTRACTING** iron from its ore, Process of. C. C. Jones, U. S. Pat. 1319589. *Of. Gas.* (Oct. 21, 1919) 267, 455. 75 w.
- FACTORY** production, Relation of heat treatment, design and selection of steels for metal casting tools to. C. P. Berg, *Jnl. Am. Steel Treat. Soc.* (Oct., 1919) 2, 7-11. 2500 w.
- FERROSILICON** and by-products, Process of making. J. E. Johnson, Jr. U. S. Pat. 1318763. *Of. Gas.* (Oct. 14, 1919) 267, 271. 55 w.
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- FOUNDRY** ladles. R. H. Stevens, British Pat. 130967. *III. Of. Jnl.* (Oct. 8, 1919) 3401. 150 w.
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- FURNACES**, Smeaton-Wright Furnaces, Ltd. J. E. Fletcher and F. Wright, British Pat. 130475. *III. Of. Jnl.* (Oct. 1, 1919) 3227. J. E. Fletcher and F. Wright, British Pat. 130475. *III. Of. Jnl.* (Oct. 1, 1919) 3227. 150 w. Gaseous fuel furnaces for metal heating, etc.
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- FURNACES**, Forced draught crucible: their possibilities. W. J. May, *Prac. Engng.* (Oct. 9, 1919) 60, 172-4. 2200 w.
- GRAY-IRON** foundry in Utah, Modern. T. F. Jennings, *Foundry* (Sept. 1, 1919) 47, 557-8. 1200 w.
- HARDENING** and tempering metals. A. Imberg, British Pat. 130533. *III. Of. Jnl.* (Oct. 1, 1919) 3246. 80 w.
- HEAT** treatment, Nichrome castings for. H. Jenkins, *Canad. Machy.* (Oct. 2, 1919) 23, 343-44. 600 w. *Raw Material* (Sept., 1919) 1, 341-2. 1200 w.
- HEAT** treatment of gun barrels. Le traitement thermique des obus. *Genie Civil* (Sept. 13, 1919) 78, 240-5. 6000 w.
- HEATING** furnaces and annealing furnaces. W. Trinka, *Blast Fur. & Steel Plant*, X. (Oct., 1919) 7, 490-3. 2500 w. Serial.
- INGOT** mold foundry, Bethlehem's. E. C. Kreutzberg, *Foundry* (Sept. 1, 1919) 47, 601-3. 1500 w.
- IRON** alloys, dependence of magnetic properties, etc. upon chemical composition, etc. Über die Abhängigkeit der magnetischen Eigenschaften, etc., von der chemischen Zusammensetzung. E. Günlich, *Elektrotechnische Ztsch.* (June 26, 1919) 312-15. 3500 w. Serial. Also (July 3, 10, 1919) 325-8, 334-6.
- IRON** and steel manufacture. L. P. Baeset, British Pat. 130610. *III. Of. Jnl.* (Oct. 1, 1919) 3274. 70 w. Iron or steel scrap melted.
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- IRON** foundry, its lay-out and operation. Die Eisengießerei, deren Anlage und Betrieb. R. Schmidt, *Ztsch. Gas. Gießereipraxis* (June 7, 1919) 305-7. 2500 w. Serial. (June 14, 1919) 317-20. 3500 w.
- MAHR** caloriser and furnace, Description of a. J. H. Rodgers, *Canad. Machy.* (Oct. 2, 1919) 23, 341-2. 700 w. Oil burning furnace for forging and heat treating.
- MAKING** bar iron mechanically. J. F. Froggett, *Iron Tr. Rev.* (Oct. 2, 1919) 68, 929-33. 2000 w. At Lebanon, Pa.
- MALLEABLE** iron, Manufacture of. H. A. Johnson, *Machy.*, London (Sept. 4, 1919) 14, 686-7. 2200 w.

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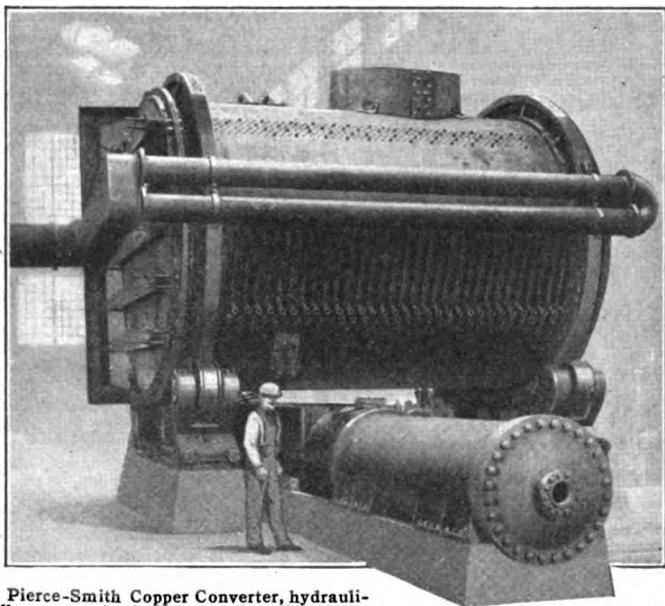
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- MALLEABLE** iron, Sulphur reduced in. A. W. Merrick, *Foundry* (Oct. 1, 1919) 47, 685-7. 2000 w. Read before Am. Fdy. Assn., Sept. 29, 1919.
- MANUFACTURE** of iron and steel, Report on fuel economy and consumptions in the. W. A. Bone, R. Hadfield, and A. Hutchinson, Iron and Steel Inst. *Advance Copy* (Sept., 1919) 42 pp.
- MELTING** shop at the Lanarkshire Steel Works, New. *Iron & Coal Tr. Rev.* (Oct. 3, 1919) 99, 437. 1000 w.
- METALLURGICAL** furnaces, Fuel control in. R. Hadfield, and R. J. Sarant, Iron and Steel Inst. *Advance Copy* (Sept., 1919) 13 pp.
- MOLDING**, Lost wax process of. C. Vickers, *Brass Wld.* (Sept., 1919) 15, 271-2. 2000 w.
- MOLDING**, Permanent mold or new method of. F. B. Gordon, *Canad. Foundryman* (June, 1919) 10, 147. 1000 w.
- MOLDING** sand practice, Compare. P. G. H. Boswell, *Foundry* (Sept. 1, 1919) 47, 592-5. 4000 w. Molding sand and foundry practice of Britain and America.
- MOLDING-MACHINE** for foundry use. J. B. Neesham, U. S. Pat. 1318101. *Off. Gas.* (Oct. 7, 1919) 267, 83-4. 65 w.
- MOLDING** machine, New. Nouvelles machines a mouler. *Fonderie Moderne* (April, 1919) 77-80. 1200 w.
- NICU-STEEL**—Its manufacture and uses. H. A. Morrin, *Raw material* (Sept., 1919) 1, 343-4. 1000 w.
- PUDDLING** furnaces, Powdered fuel for. W. Simons, *Engng.* (Sept., 26, 1919) 108, 430. 500 w. Read before Iron and Steel Inst., Sept. 18, 1919.
- ROLLING** or forming car wheels or other circular bodies, Method of and means for. L. F. Dieter, U. S. Pat. 1319141. *Off. Gas.* (Oct. 21, 1919) 267, 369. 650 w.; U. S. Pat. 1319142. 369-70. 800 w.
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- SEMI-STEEL** and general foundry practice. D. Mc Lain, *Canad. Foundryman* (July, 1919) 10, 180-3. 5000 w. Read before the Southern Metal Trades Assn., May, 1919.
- SLAGS**, Process of treating. U. A. Garred, U. S. Pat. 1319061. *Off. Gas.* (Oct. 21, 1919) 267, 354. 55 w.
- SMELTING** furnace with crucibles of quartz glass. Schmelzofen mit tiegeln aus quarzglas odor quarzglas. *Metall-Technik* (July 12, 1919), 106. 700 w.
- SMELTING** iron ores. Compagnie des Forges de Chatillon Commentry et Neuves Maisons. British Pat. 129957. *Ill. Off. Jnl.* (Sept. 17, 1919). 3019. 45 w.
- SMELTING** of iron ores in British Columbia. Commercial feasibility of the electric. A. Stansfield, *Bull. Canad. Mine Inst.* (Oct., 1919) 1027-31. 1400 w.
- SMELTING** of iron ores, New method for the. J. W. Moffat, *Canad. Foundryman* (May, 1919) 10, 119-21. 3000 w.
- SPECIFIC** heat during melting and the heat of fusion of some metals, On the variation of. I. Iitaka, *Sci. Repts. Tohoku Imp. Univ.* (Aug., 1919) 8, 99-114.
- STEEL**. J. C. Sellers, British Pat. 129676. *Ill. Off. Jnl.* (Sept. 17, 1919) 2920. 150 w. For bullet-proof plates.
- STEEL**, Effect of time and low temperature on physical properties of medium carbon. *Bull. A.I.M.E.* (Oct., 1919) 2935-7. 900 w. Discussion of the paper of G. A. Reinhardt and H. L. Cutler.
- STEEL** and railroad rails at the Austro-Hungarian works, Manufacture of. Die erzeugung von stahl und eisenbahnschienen der österreichisch-ungarischen werke. F. Schuster, *Mon. Rundschau* (July 1, 1919) 403-6. Tables. 1000 w.
- STEEL** chips and steel filings in blast furnaces, Use of. Empleo de virutas y liendaduras de acero en los hornos altos. *Revista Minera* (Sept. 16, 1919) 452-3. 800 w.
- STEEL**, Determination of liquid. Determinazione della temperatura dell'acciaio liquido nelle condizioni industriali. *Rassegna Mineraria* (Aug., 1919) 81, 27-9. 1700 w.
- STEEL** ingots, Method and apparatus for forming. T. M. Whalen, U. S. Pat. 1319500. *Off. Gas.* (Oct. 21, 1919) 267, 438. 70 w.
- STEEL** in the iron foundry, Making. G. P. Fisher, *Foundry* (Oct. 1, 1919) 47, 693-4. 1500 w. Read before Am. Fdy. Assn., Sept. 29, 1919.
- TEMPERATURE** measurements, Refractory materials and high. C. W. Kanolt, *Jnl. Franklin Inst.* (Oct., 1919) 188, 489-505.
- TEMPERING** metals, Process of. T. J. Fay, U. S. Pat. 1318367. *Off. Gas.* (Oct. 14, 1919) 267, 196. 45 w.
- WEIRTON** blows in new blast furnace. *Blast Fur. & Steel Plant* (Oct., 1919) 7, 510-6, 525-6000 w.
- WHEEL** foundry of the Pennsylvania Railroad Co. at South Altoona, Pa., New. Die neue rädergießerei der Pennsylvania Railroad Co. in South Altoona, Pa., Amerika. *Ztsch. Ges. Eisenverpraxis* (July 5, 1919) 361-2. 1500 w.

## ELECTRO

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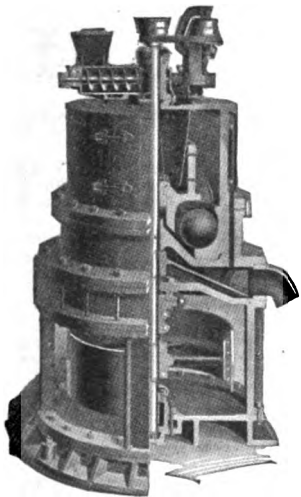
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**Converters, Copper**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Converters, Electric, Rotary**

General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Conveyors, Belt**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Robins Conveying Belt Co., Park Row Bldg., New York City.

**Conveyors, Cable Flight**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Chain Flight**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Pan or Apron**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Conveyors, Screw**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Core Drilling**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.  
Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Crucibles**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.

**Crushers, Coal and Coke**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Crushers, Disc**

Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.

**Crushers, Jaw**

Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.

**Crushers, Ore**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Buchanan Co., C. G., 90 West St., New York City.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Fuller-Lehigh Co., Fullerton, Pa.  
Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Crushing and Grinding Machinery**

Chalmers & Williams, Inc., 1468 Arnold St., Chicago Heights, Ill.

**Crushing Roll Parts**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
Chalmers & Williams, Inc., Chicago Heights, Ill.

**Crushing Rolls (See Rolls, Crushing)****Cupro-Vanadium**

Primos Chemical Co., Primos, Pa.

**Cyanide**

Roessler & Haenschel Chemical Co., 100 William St., New York City.

**Cyaniding Equipment**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.

Colorado Iron Works Co., Denver, Colo.

Dorr Co., Denver, Colo.

Mine and Smelter Supply Co., 42 Broadway, New York City.

National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.

Traylor Engineering & Mfg. Co., Allentown, Pa.

Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Cyanide Plants**

National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.

**Dead Burned Magnesite**

Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.

**Dewaterers**

Colorado Iron Works Co., Denver, Colo.

Dorr Co., Denver, Colo.

National Tank & Pipe Co., 275 Y Oak St., Portland, Ore.

Traylor Engineering & Mfg. Co., Allentown, Pa.

**Diamond Drilling**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.

**Dredging Machinery**

Flory Mfg. Co., S., Bangor, Pa.

**Drill Hole Compass (See Compass, Drill Hole)****Drills, Core**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.

Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Drills, Diamond**

Longyear Co., E. J., 710 Security Bldg., Minneapolis, Minn.

Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Drills, Electric**

General Electric Co., Schenectady, N. Y.

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Drills, Hammer**

Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Drills, Prospecting**

Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Drills, Rock**

Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.

**Dryers, Coal**

Ruggles-Coles Engineering Co., 50 Church St., New York City.

**Dryers, Ore**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Ruggles-Coles Engineering Co., 50 Church St., New York City.

Traylor Engineering & Mfg. Co., Allentown, Pa.

Wedge Mechanical Furnace Co., Greenwich Point, Philadelphia, Pa.

**Dryers, Rotary**

Fuller-Lehigh Co., Fullerton, Pa.

Ruggles-Coles Engineering Co., 50 Church St., New York City.

**Dryers, Sand and Gravel**

Ruggles-Coles Engineering Co., 50 Church St., New York City.

**Dumps, Rotary**

Car Dumper and Equipment Co., McCormick Bldg., Chicago, Ill.

**Dynamite**

Atlas Powder Co., Wilmington, Del.

Du Pont de Nemours & Co., E. I., Wilmington, Del.

Hercules Powder Co., Wilmington, Del.

**Dynamos (See Generators, Electric)****Electrical Machinery**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

General Electric Co., Schenectady, N. Y.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Elevators, Bucket**

Bushanan Co., C. G., 90 West St., New York City.

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

Mine and Smelter Supply Co., 42 Broadway, New York City.

Robins Conveying Belt Co., Park Row Bldg., New York City.

Traylor Engineering & Mfg. Co., Allentown, Pa.

Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**End Loaders (See Loaders, End)****Engines, Gas and Gasoline**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Engines, Haulage**

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Engines, Hoisting**

Flory Mfg. Co., S., Bangor, Pa.

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

**Engines, Oil**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Engines, Steam**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Explosives**

Atlas Powder Co., Wilmington, Del.

Du Pont de Nemours & Co., E. I., Wilmington, Del.

Hercules Powder Co., Wilmington, Del.

**Fans, Ventilating**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Feeders, Ore**

Buchanan Co., C. G., 90 West St., New York City.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robbins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

**Ferro-Molybdenum**

Primos Chemical Co., Primos, Pa.

**Ferro-Tungsten**

Primos Chemical Co., Primos, Pa.

**Ferro-Vanadium**

Primos Chemical Co., Primos, Pa.

**Filtering Paper**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Filters**

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

**Fire Clay**

Harrison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.

**Flotation, Oil**

Colorado Iron Works Co., Denver, Colo.

**Fluorescent Calcium Tungstate**

Primos Chemical Co., Primos, Pa.

**Forgings, Heavy**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Fuller Mill Parts**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

**Furnaces, Assay**

Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.

**Furnaces, Electric**

General Electric Co., Schenectady, N. Y.  
 Hell Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

**Furnaces, Mechanical Roasting**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Wedge Mechanical Furnace Co., Greenwich Point, Philadelphia, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Furnaces, Oil**

Mine and Smelter Supply Co., 42 Broadway, New York City.

**Furnaces, Smelting**

Colorado Iron Works Co., Denver, Colo.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

**Gears**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.

**Generators, Electric**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 General Electric Co., Schenectady, N. Y.  
 Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

**Grinders, Sample**

Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

**Grizzly & Riffe Bars (For Hydraulic Mines)**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.

**Gyratory Crusher Parts**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.

**Hitchings Mine Car**

Masomer & Whyte Rope Co., Kenosha, Wis.

**Holsting Engines (See Engines, Holsting)****Hoists, Electric**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Flory Mfg. Co., S. Bangor, Pa.  
 General Electric Co., Schenectady, N. Y.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

**Hoists, Skip**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

**Hoists, Steam**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Flory Mfg. Co., S. Bangor, Pa.  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Sullivan Machinery Co., 123 So. Michigan Ave., Chicago, Ill.  
 Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.

**Hoppers, Weigh**

Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.

**Hose, Air**

Goodrich Rubber Co., B. F., Akron, O.

**Hydraulic Machinery**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Jackets, Water**

Traylor Engineering & Mfg. Co., Allentown, Pa.

**Jaw Crusher Parts**

American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.

**Jigs**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Colorado Iron Works Co., Denver, Colo.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Kilns, Rotary**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Kilns, Rotary, Ore Nodulizers**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Laboratory Supplies**  
Hull Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Lamps, Electric**  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Lead Acetate**  
Hull Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Limings, Ball and Tube**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Litharge**  
Hull Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Loaders, End**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Loading Booms**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Locomotives, Compressed Air**  
General Electric Co., Schenectady, N. Y.  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Electric Trolley**  
General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Locomotives, Gasoline**  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Steam**  
Vulcan Iron Works, 1744 Main St., Wilkes-Barre, Pa.
- Locomotives, Storage Battery**  
General Electric Co., Schenectady, N. Y.  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Magnesia Brick**  
Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Magnetic Pulleys (See Pulleys, Magnetic)**
- Metals, Perforated**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Motors, Electric**  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Mills, Ball, Tube and Pebble**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Fuller-Lehigh Co., Fullerton, Pa.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Mills, Chilean**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.
- Mills, Stamp**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Traylor Engineering & Mfg. Co., Allentown, Pa.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Mine Car Hitchings (See Hitchings, Mine Car)**
- Mining Machinery**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.
- Molybdate of Ammonia**  
Primos Chemical Co., Primos, Pa.
- Molybdate of Calcium**  
Primos Chemical Co., Primos, Pa.
- Molybdate of Soda**  
Primos Chemical Co., Primos, Pa.
- Molybdenum Metal**  
Primos Chemical Co., Primos, Pa.
- Molybdenum Ore, Buyers of**  
Primos Chemical Co., Primos, Pa.
- Molybdic Acid**  
Primos Chemical Co., Primos, Pa.
- Motors, Electric**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
General Electric Co., Schenectady, N. Y.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
- Muffles**  
Mine and Smelter Supply Co., 42 Broadway, New York City.
- Nodulizers**  
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
- Ore-Bedding Systems**  
Robins Conveying Belt Co., Park Row Bldg., New York City.
- Ore Handling Machinery**  
Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
Robins Conveying Belt Co., Park Row Bldg., New York City.
- Ore Milling Machinery**  
Chalmers & Williams, Inc., Chicago Heights, Ill.  
Colorado Iron Works Co., Denver, Colo.  
Mine and Smelter Supply Co., 42 Broadway, New York City.  
Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Ores, Buyers and Sellers of**  
Vogelstein & Co., Inc., L., 42 Broadway, New York City.
- Packings, Steam**  
Goodrich Rubber Co., B. F., Akron, O.
- Plate Metal Work**  
Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Platinum Wire, Felt & Ware**  
Hull Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

- Powder, Blasting**  
 Atlas Powder Co., Wilmington, Del.  
 Du Pont de Nemours & Co., E. I., Wilmington, Del.  
 Hercules Powder Co., Wilmington, Del.
- Powdered Coal Equipment**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Ruggles-Coles Engineering Co., 50 Church St., New York City.
- Power Transmission Machinery**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Presses, Filter**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pulleys, Magnetic**  
 Buchanan Co., C. G., 90 West St., New York City.
- Pulverizer Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Pulverizers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Pulverizers, Coal and Coke**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pulverizers, Ore**  
 Fuller-Lehigh Co., Fullerton, Pa.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Acid**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Centrifugal**  
 Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Hydraulic Pressure**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Mine**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.
- Pumps, Pneumatic Air Lift**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Pumps, Power**  
 Epping-Carpenter Pump Co., Pittsburgh, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Sand**  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.
- Pumps, Sinking**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Stuff**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumps, Track**  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Pumping Engines (See Engines, Pumping)**
- Pyrometers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Quarrying Machinery**  
 Sullivan Machinery Co., 122 So. Michigan Ave., Chicago, Ill.
- Refractories**  
 Harbison-Walker Refractories Co., Farmers' Bank Bldg., Pittsburgh, Pa.
- Respirators**  
 Goodrich Rubber Co., B. F., Akron, O.  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Revolving Screen Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.  
 Chalmers & Williams, Inc., Chicago Heights, Ill.
- Rock Drill Steel (See Steel, Drill)**
- Rods, Drill**  
 International High Speed Steel Co., 90 Nassau St., New York, N. Y.
- Roller Mill Parts**  
 American Manganese Steel Co., McCormick Bldg., Chicago, Ill.
- Rolls, Crushing**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Rope, Wire**  
 Leechen & Sons Rope Co., A., 920 N. 1st St., St. Louis, Mo.  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Rope Fastenings, Wire**  
 Macomber & Whyte Rope Co., Kenosha, Wis.  
 Roebling's Sons Co., John A., Trenton, N. J.
- Rubber Goods, Mechanical**  
 Goodrich Rubber Co., B. F., Akron, O.
- Samplers, Ore**  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.  
 Worthington Pump & Machinery Corp'n., 115 Broadway, New York City.
- Scorifiers**  
 Heil Chemical Co., Henry, 210-214 S. 4th St., St. Louis, Mo.
- Screens, Bar**  
 Holmes & Bros., Inc., Robt., 30 N. Hazel St., Danville, Ill.
- Screens, Perforated Metal**  
 Chalmers & Williams, Inc., Chicago Heights, Ill.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.
- Screens, Revolving**  
 Buchanan Co., C. G., 90 West St., New York City.  
 Chalmers & Williams, Inc., 1465 Arnold St., Chicago Heights, Ill.  
 Colorado Iron Works Co., Denver, Colo.  
 Jeffrey Mfg. Co., 902 N. 4th St., Columbus, Ohio.  
 Mine and Smelter Supply Co., 42 Broadway, New York City.  
 Robins Conveying Belt Co., Park Row Bldg., New York City.  
 Traylor Engineering & Mfg. Co., Allentown, Pa.

## CLASSIFIED LIST OF MINING AND METALLURGICAL EQUIPMENT

**Screens, Revolving (Continued)**

Worthington Pump & Machinery Corp'n.,  
115 Broadway, New York City.

**Screens, Shaking**

Chalmers & Williams, Inc., 1465 Arnold St.  
Chicago Heights, Ill.

Holmes & Bros., Inc., Robt., 30 N. Hazel St.,  
Danville, Ill.

**Separators, Magnetic**

Buchanan Co., C. G., 90 West St., New York  
City.

**Shaft Sinking and Development Work**

Longyear Co., E. J., 710 Security Bldg.,  
Minneapolis, Minn.

**Sharpeners, Drill**

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Silica Brick**

Harblson-Walker Refractories Co., Farmers'  
Bank Bldg., Pittsburgh, Pa.

**Skip Hoists (See Hoists, Skip)**

Macomber & Whyte Rope Co., Kenosha, Wis.  
Roebbling's Sons Co., John A., Trenton, N. J.

**Slime Filters (See Filters)****Smelters**

Vogelstein & Co., Inc., L., 42 Broadway,  
New York City.

**Smelting Machinery**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
Colorado Iron Works Co., Denver, Colo.

Traylor Engineering & Mfg. Co., Allentown,  
Pa.

Worthington Pump & Machinery Corp'n.,  
115 Broadway, New York City.

**Soda Ash**

Hell Chemical Co., Henry, 210-214 S. 4th St.,  
St. Louis, Mo.

**Spelter**

Illinois Zinc Co., Peru, Ill.

**Sprockets**

American Manganese Steel Co., McCormick  
Bldg., Chicago, Ill.

**Stamp Mill Parts**

American Manganese Steel Co., McCormick  
Bldg., Chicago, Ill.

Chalmers & Williams, Inc., Chicago Heights,  
Ill.

**Steel, Drill, Hollow and Solid**

International High Speed Steel Co., 99 Nas-  
sau St., New York, N. Y.

Sullivan Machinery Co., 122 So. Michigan  
Ave., Chicago, Ill.

**Steel, Tool**

International High Speed Steel Co., 99 Nas-  
sau St., New York, N. Y.

**Stokers**

Westinghouse Electric & Mfg. Co., East  
Pittsburgh, Pa.

**Switchboards**

General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East  
Pittsburgh, Pa.

**Tables, Concentrating (See Concentrators)****Tanks, Cyanide**

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

**Tanks, Oil**

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

**Tanks, Water**

National Tank & Pipe Co., 275 Y Oak St.,  
Portland, Ore.

**Test Lead**

Hell Chemical Co., Henry, 210-214 S. 4th St.,  
St. Louis, Mo.

**Thermometers**

Hell Chemical Co., Henry, 210-214 S. 4th St.,  
St. Louis, Mo.

**Thickeners, Slime**

Colorado Iron Works Co., Denver, Colo.  
Dorr Co., Denver, Colo.

**Tipple Machinery Equipment**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
Ohio.

**Towers and Bridges, Stocking and Reclaiming**

Robins Conveying Belt Co., Park Row Bldg.,  
New York City.

**Tramways, Wire Rope, Aerial**

Leachen & Sons Rope Co., A., 920 N. 1st St.,  
St. Louis, Mo.

Macomber & Whyte Rope Co., Kenosha, Wis.  
Roebbling's Sons Co., John A., Trenton, N. J.

**Transformers, Electric**

General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East  
Pittsburgh, Pa.

**Tungstate of Ammonia**

Primos Chemical Co., Primos, Pa.

**Tungstate of Soda**

Primos Chemical Co., Primos, Pa.

**Tungsten Ore, Buyers of**

Primos Chemical Co., Primos, Pa.

**Tungstic Acid**

Primos Chemical Co., Primos, Pa.

**Turbines, Hydraulic**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

**Turbines, Steam**

Allis-Chalmers Mfg. Co., Milwaukee, Wis.  
General Electric Co., Schenectady, N. Y.  
Westinghouse Electric & Mfg. Co., East  
Pittsburgh, Pa.

**Valves, Pump**

Goodrich Rubber Co., B. F., Akron, O.

**Vanadate of Ammonia**

Primos Chemical Co., Primos, Pa.

**Vanadic Acid**

Primos Chemical Co., Primos, Pa.

**Vanadium Chloride**

Primos Chemical Co., Primos, Pa.

**Vanadium Ore, Buyers of**

Primos Chemical Co., Primos, Pa.

**Ventilating Fans (See Fans, Ventilating)****Wagon Loaders**

Jeffrey Mfg. Co., 902 N. 4th St., Columbus,  
Ohio.

**Weigh Hoppers (See Hoppers, Weigh)****Wheels**

American Manganese Steel Co., McCormick  
Bldg., Chicago, Ill.

**Wheels, Mine Car**

Fuller-Lehigh Co., Fullerton, Pa.

**Wire, Iron, Steel and Copper**

Roebbling's Sons Co., John A., Trenton, N. J.

**Wire Mechanism (Lever Control)**

Gwiliam Co., 253 W. 58th St., New York  
City.

**Wire Rope (See Rope, Wire)****Wires and Cables, Electrical**

General Electric Co., Schenectady, N. Y.  
Goodrich Rubber Co., B. F., Akron, O.  
Roebbling's Sons Co., John A., Trenton, N. J.

**Zinc Dust**

Vogelstein & Co., Inc., L., 42 Broadway,  
New York City.

**Zinc Sheet**

Illinois Zinc Co., Peru, Ill.

## ALPHABETICAL LIST OF ADVERTISERS

(With Summary of Products)

*See pages 35-41 for Classified List of Mining and Metallurgical Equipment*

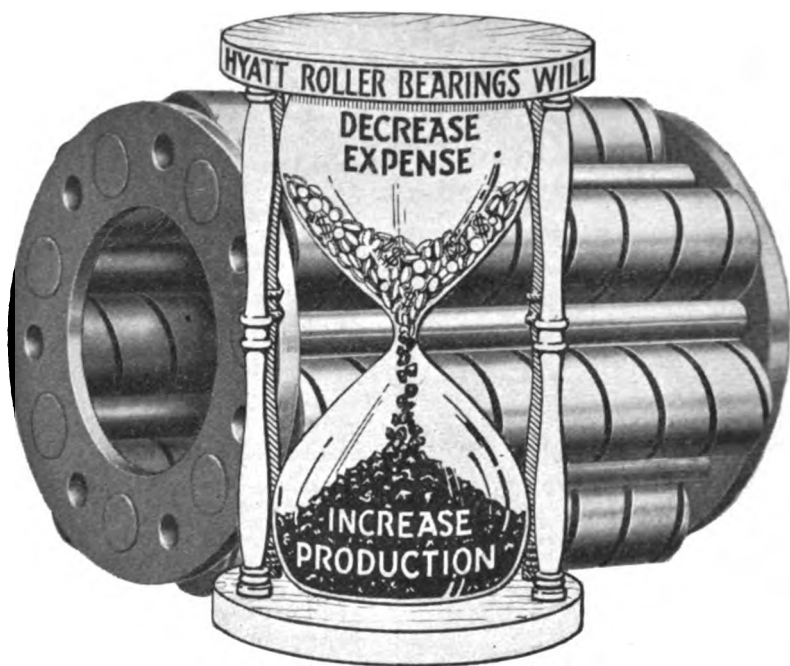
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| <b>Allis-Chalmers Mfg. Co.</b> ..... *  |      | <b>Du Pont de Nemours &amp; Co., E. I.,</b> ... 9  |      |
| ADDRESS: Milwaukee, Wis.  |      | ADDRESS: Wilmington, Del.  |      |
| PRODUCTS: Mining Machinery of Every Type. Complete Power and Electrical Equipments.   |      | PRODUCTS: Explosives, Blasting Powder, Dynamite, etc.  |      |
| <b>American Manganese Steel Co.</b> ..... *   |      | <b>Flory Mfg. Co., S.</b> ..... *  |      |
| ADDRESS: McCormick Building, Chicago, Ill.  |      | ADDRESS: Bangor, Pa.   |      |
| PRODUCTS: Castings for Mining Machinery Parts.  |      | PRODUCTS: Mine and Contractors' Hoists, Cableways, Capstans, Winches, Marine Railway Hoists, etc.  |      |
| <b>Atlas Powder Co.</b> ..... 7   |      | <b>Fuller-Lehigh Co.</b> ..... 25  |      |
| ADDRESS: Wilmington, Del.   |      | ADDRESS: Fullerton, Pa.  |      |
| PRODUCTS: Manufacturers of Explosives.  |      | PRODUCTS: The Fuller-Lehigh Pulveriser Mill, Cement Mill Machinery, Powdered Coal Equipment, Gyratory Crushers, Roll Crushers, Rotary Dryers, Car Wheels and Axles, Chemical Castings, Charcoal Iron Castings, Chilled Castings.   |      |
| <b>Buchanan Co., C. G.</b> ..... 17   |      | <b>General Electric Co.,</b>   |      |
| ADDRESS: 90 West St., New York City.  |      | Outside Back Cover   |      |
| PRODUCTS: Crushing and Magnetic Concentrating Plants Complete in All Details. Rock and Ore Crushers, Crushing Rolls, Magnetic Separators, Revolving Screens, Bucket Elevators, Ore Feeders. |      | ADDRESS: Schenectady, N. Y.  |      |
| <b>Car Dumper and Equipment Co.</b> ..... *   |      | PRODUCTS: Electric Mine Locomotives, Electric Motors for Operating Mining Machinery.   |      |
| ADDRESS: McCormick Bldg., Chicago, Ill.   |      | <b>Goodrich Rubber Co., B. F.</b> ..... *  |      |
| PRODUCTS: The Pneumatic Rotary Dump (Wood and Ramsay Patents). Adaptable to all mining conditions—old or new operations.  |      | ADDRESS: Akron, O.   |      |
| <b>Chalmers &amp; Williams, Inc.</b> ..... 19   |      | PRODUCTS: Goodrich "Longlife," "Dredge," Vanner, Take-off and Magnetic Separator Conveyor Belts.   |      |
| ADDRESS: 1465 Arnold St., Chicago Heights, Ill.   |      | <b>Gwilliam Co.</b> ..... *  |      |
| PRODUCTS: Mining and Crushing Machinery.  |      | ADDRESS: 283 W. 58th St., New York City.   |      |
| <b>Colorado Iron Works Co.,</b>   |      | PRODUCTS: Ball and Roller Bearings. The Bowden Patent Wire Mechanism for the Transmission of Reciprocating Motion Through a Flexible and Tortuous Route.   |      |
| Inside Front Cover  |      | <b>Harbison-Walker Refractories Co.</b> ..... *  |      |
| ADDRESS: Denver, Colo.  |      | ADDRESS: Pittsburg, Penna.   |      |
| PRODUCTS: Complete Equipment for Cyanide and Concentrating Mills and Smelting Plants.   |      | PRODUCTS: Refractories for Blast Furnace and the Open Hearth, Electrical Furnaces, Copper Smelting Plants, Lead Refineries, Nickel Smelters, Silver Slimes and Dross Furnaces, Alloy Furnaces, as well as all other types in use in the various metallurgical processes. |      |
| <b>Deister Concentrator Co.</b> ..... *   |      | <b>Heil Chemical Co., Henry</b> ..... *  |      |
| ADDRESS: Ft. Wayne, Ind.  |      | ADDRESS: 210-214 S. 4th St., St. Louis, Mo.  |      |
| PRODUCTS: Deister, Overstrom and Deister-Overstrom Tables in either Single or Double Deck Types.  |      | PRODUCTS: Chemicals and Chemical Apparatus. Supplies for Mines, Smelters, Iron and Steel Works, Schools, Colleges, and Universities.   |      |
| <b>Denver Hydro Co.</b> ..... *   |      | <b>Hercules Powder Co.</b> ..... *   |      |
| ADDRESS: 3100 Stuart St., Denver, Colo.   |      | ADDRESS: Wilmington, Del.  |      |
| PRODUCTS: Hydraulic Air Compressors, Exelsior Altimeters, The Sentinel Automatic Valve.   |      | PRODUCTS: Explosives, Blasting Powder, Dynamite, etc.  |      |
| <b>Derby, Jr., E. L., Agent</b> ..... *   |      | <b>Holmes &amp; Bros., Inc., Robt.</b> ..... 11  |      |
| ADDRESS: Ishpeming, Mich.   |      | ADDRESS: 30 N. Hazel St., Danville, Ill.   |      |
| PRODUCTS: The Mass Drill Hole Compass for determining direction and dip.  |      | PRODUCTS: Engineers, Founders, Machinists and Boiler Makers. Builders of Hoisting and Haulage Engines, Shake Screens and Weigh Hoppers, Self Dumping Cages and Empty Car Lifts, Mill and Mine Supplies.  |      |
| <b>Dorr Co.</b> ..... *   |      |  |      |
| ADDRESS: Denver, Colo.  |      |  |      |
| PRODUCTS: Machinery in use for Cyaniding. Wet Gravity Concentration, Flotation, Leaching Copper Ores and many non-metallurgical industrial processes.                                       |      |  |      |

\*Advertisement does not appear in this issue, but products are listed in Classified List of Mining Metallurgical Equipment.

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| <b>Hyatt Roller Bearing Co.</b> .....   | 44                | <b>Primos Chemical Co.</b> .....   | 27     |
| ADDRESS: Metropolitan Tower, New York.  |                   | ADDRESS: Primos, Pa.   |        |
| PRODUCTS: Roller Bearings.  |                   | PRODUCTS: Molybdenum, Tungsten and Vanadium Products. Buyers of Molybdenum, Tungsten and Vanadium Ores.  |        |
| <b>Illinois Zinc Co.</b> .....  | *                 | <b>Robins Conveying Belt Co.</b> .....   | *      |
| ADDRESS: Peru, Ill.   |                   | ADDRESS: Park Row Bldg., New York City.  |        |
| PRODUCTS: Spelter, Sheet Zinc and Sulphuric Acid.   |                   | PRODUCTS: Belt Conveyors, Bucket Elevators, Ore Bedding Systems, Unloading, Stocking and Reclaiming Towers and Bridges, Conveyor Auxiliaries.  |        |
| <b>International High Speed Steel Co.</b> ...   | *                 | <b>Roebbling's Sons Co., John A.</b> .....   | *      |
| ADDRESS: 99 Nassau St., New York City.  |                   | ADDRESS: Trenton, N. J.  |        |
| PRODUCTS: Drill Steel, Tool Steel, Drill Rods.  |                   | PRODUCTS: Wire Rope for Mining Work. Stock shipments from agencies and branches throughout the country.  |        |
| <b>Jeffrey Mfg. Co.</b> .....   | Inside Back Cover | <b>Ruessler &amp; Hasslacher Chemical Co.</b> 29   |        |
| ADDRESS: 902 N. Fourth St., Columbus, O.  |                   | ADDRESS: 100 William St., New York.  |        |
| PRODUCTS: Electric Coal Cutters and Drills; Electric and Storage Battery Locomotives; Coal Tipping Machinery including Elevators, Conveyors, Picking Tables and Loading Booms; Car Hauls, Car Dumps, Screens, Crushers, Pulverisers, Fans, Hoists, etc. |                   | PRODUCTS: Cyanide of Sodium and Other Chemicals for Mining Purposes.   |        |
| <b>Johns-Manville Co., H. W.</b> .....  | *                 | <b>Ruggles-Coles Engineering Co.</b> .....   | *      |
| ADDRESS: New York City.   |                   | ADDRESS: 50 Church Street, New York.   |        |
| PRODUCTS: Asbestos and Rubber-type Roofings, Roof Coating, Steam Packings, Pipe Insulations, Cements, Brake Lining and Brake Blocks, Steam Traps, Third Rail Insulators, Mine Hangers, Moulded Mica Weatherproof Sockets, Electrical Tapes and Fuses.   |                   | PRODUCTS: Manufacturers of the Ruggles-Coles Dryer for All Materials. Powdered Coal Equipment.   |        |
| <b>Leschen &amp; Sons Rope Co., A.</b> .....  | *                 | <b>Sullivan Machinery Co.</b> .....  | *      |
| ADDRESS: St. Louis, Mo.   |                   | ADDRESS: 122 S. Michigan Ave., Chicago, Ill.   |        |
| PRODUCTS: Wire Rope for all purposes, including Hercules Red Strand Wire Rope, and Wire Ropes of Patent Flattened Strand and Locked Coil constructions. Aerial Wire Rope Tramways for economical transportation of material.                            |                   | PRODUCTS: Coal Pick Machines, Air Compressors, Diamond Core Drills, Rock Drills, Hammer Drills, Mine Hoists, Chain Cutter, Bar Machines, Fans.   |        |
| <b>Longyear Co., E. J.</b> .....  | *                 | <b>Traylor Engineering &amp; Mfg. Co.</b> .....  | 21     |
| ADDRESS: 710 Security Bldg., Minneapolis, Minn.   |                   | ADDRESS: Allentown, Pa.  |        |
| PRODUCTS: Contract Diamond Drilling, Manufacture of Diamond Drills and Supplies, Shaft Sinking and Development Work, Geological Department.   |                   | PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.   |        |
| <b>Macomber &amp; Whyte Rope Co.</b> .....  | *                 | <b>Vogelstein &amp; Co., Inc., L.</b> .....  | *      |
| ADDRESS: Kenosha, Wis.  |                   | ADDRESS: 42 Broadway, New York.  |        |
| PRODUCTS: Monarch Whyte Strand Wire Rope, Patent Kilindo Non-Rotating Wire Rope, Wire Rope of all Grades and Constructions. Patent Monarch Mine Car Hitchings.  |                   | PRODUCTS: Buyers, Smelters and Refiners of Ores and Metals of all classes.   |        |
| <b>Mine &amp; Smelter Supply Co.</b> .....  | *                 | <b>Vulcan Iron Works.</b> .....  | 5      |
| ADDRESS: 42 Broadway, New York City.  |                   | ADDRESS: Wilkes-Barre, Pa.   |        |
| PRODUCTS: Manufacturers of Mining, Milling, Smelting and Crushing Machinery.  |                   | PRODUCTS: Vulcan Electric Mine Hoists, Steam Hoists, Hoisting and Haulage Engines, Mining Machinery, etc. Nicholson Device for Prevention of Overwinding.  |        |
| <b>National Tank &amp; Pipe Co.</b> .....   | *                 | <b>Wedge Mechanical Furnace Co.</b> .....  | *      |
| ADDRESS: 275 Y Oak St., Portland, Ore.  |                   | ADDRESS: Greenwich Point, Philadelphia, Pa.  |        |
| PRODUCTS: Water, Oil, Mining and Cyanide Tanks; Cross Arms and Silos.   |                   | PRODUCTS: The Wedge Mechanical Roasting Furnace (Patented).  |        |
| <b>Obermayer Co., S.</b> .....  | *                 | <b>Westinghouse Electric &amp; Mfg. Co.</b> ... 15   |        |
| ADDRESS: Pittsburgh, Pa.  |                   | ADDRESS: East Pittsburgh, Pa.  |        |
| PRODUCTS: Foundry Parting, High Temperature Cement.   |                   | PRODUCTS: The Baldwin-Westinghouse Electric Mine Locomotives. Electrical Machinery: Turbines, Generators, Motors, etc.   |        |
| <b>Portable Machinery Co.</b> .....   | *                 | <b>Worthington Pump and Machinery Corp'n.</b> .....  | 13, 23 |
| ADDRESS: Passaic, N. J.   |                   | ADDRESS: 115 Broadway, New York.   |        |
| PRODUCTS: Manufacturers of the Scoop Conveyor.  |                   | PRODUCTS: Laidlaw Feather Valve Air Compressors, Direct Acting and Centrifugal Pumps, Power Pumps, Rock and Ore Crushers, Crushing Rolls, Tube Mills, Converters, Woodbury Jigs, Snow Oil Engines. |        |

\*Advertisement does not appear in this issue, but products are listed in Classified List of Mining and Metallurgical Equipment.



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